SCIENTIFIC AMERICAN

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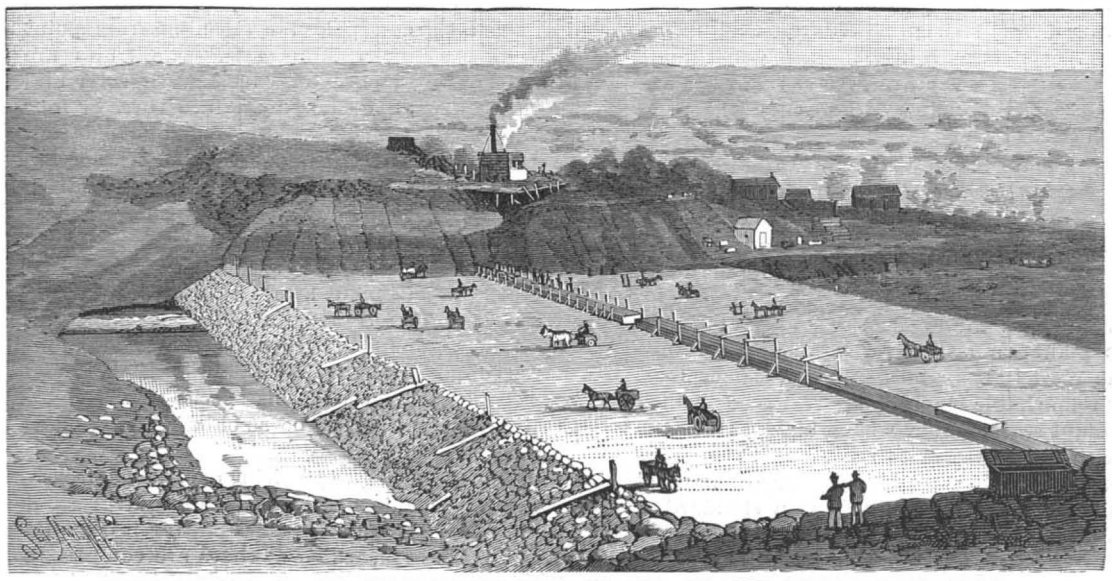

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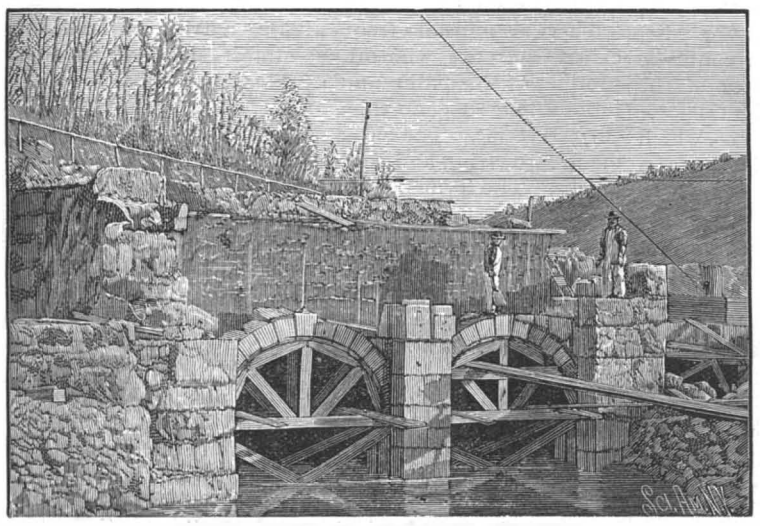

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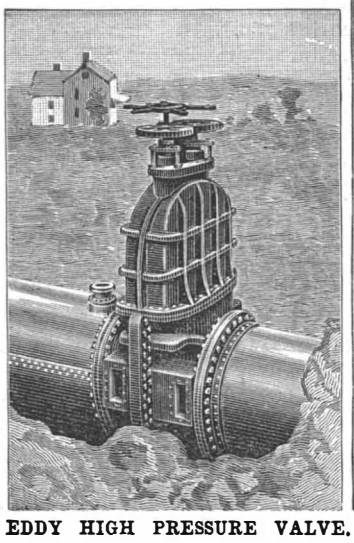

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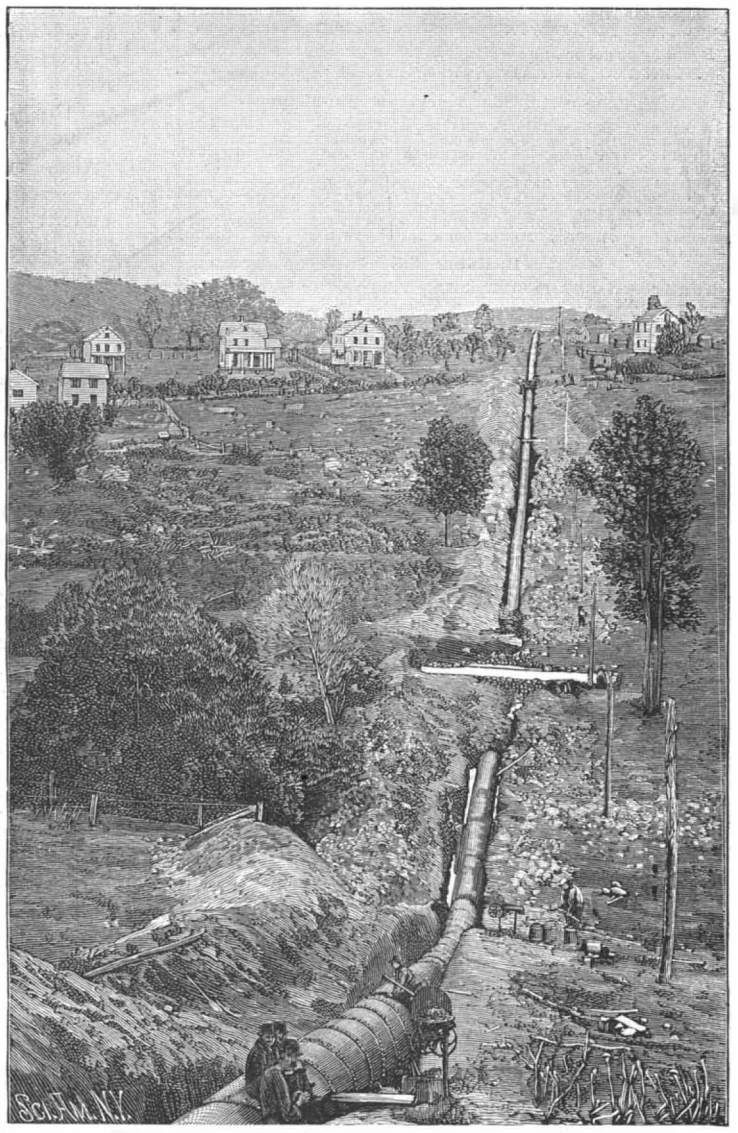

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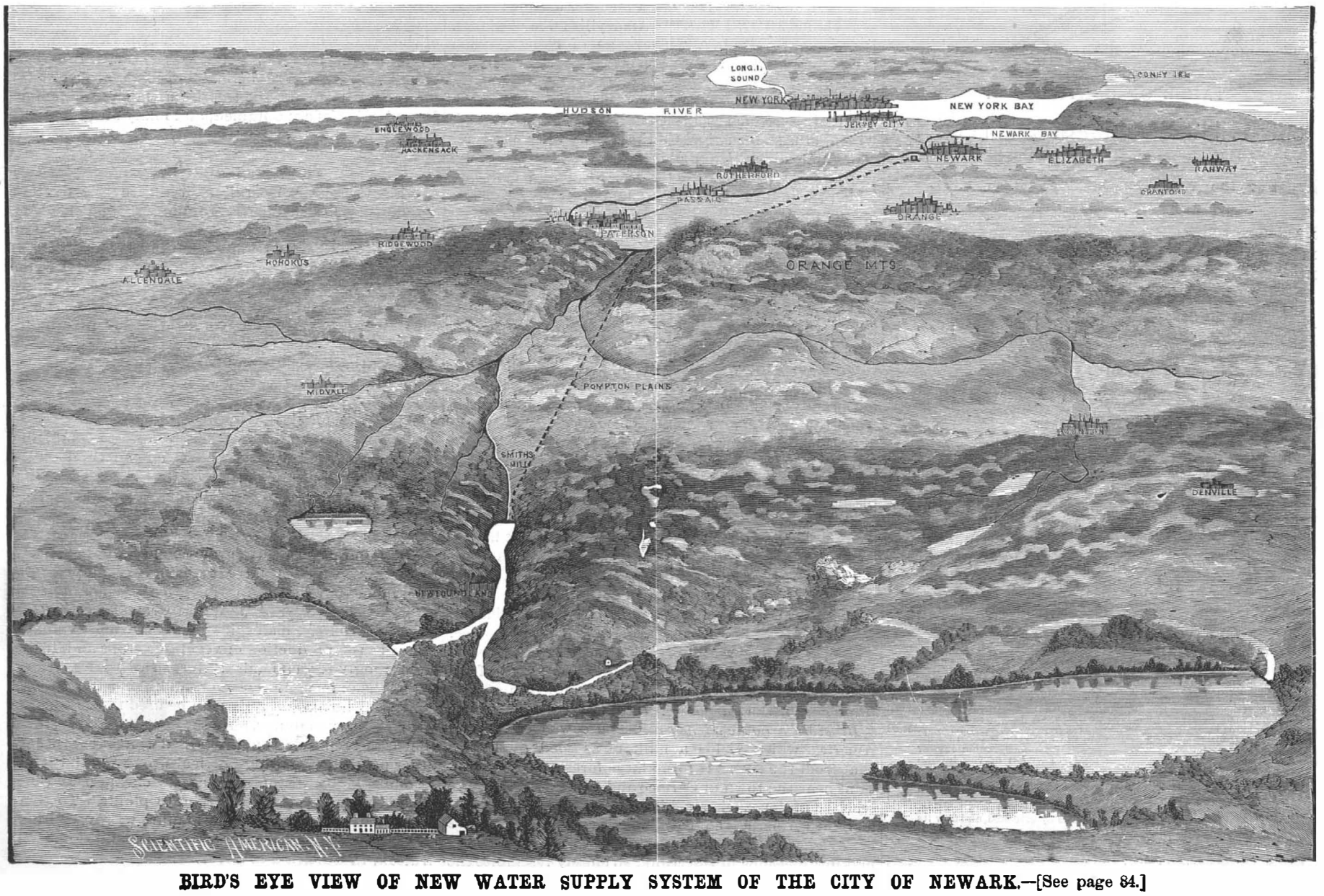

BIRD'S EYE VIEW OF NEW WATER SUPPLY SYSTEM OF THE CITY OF NEWARK.—[See page 84.]

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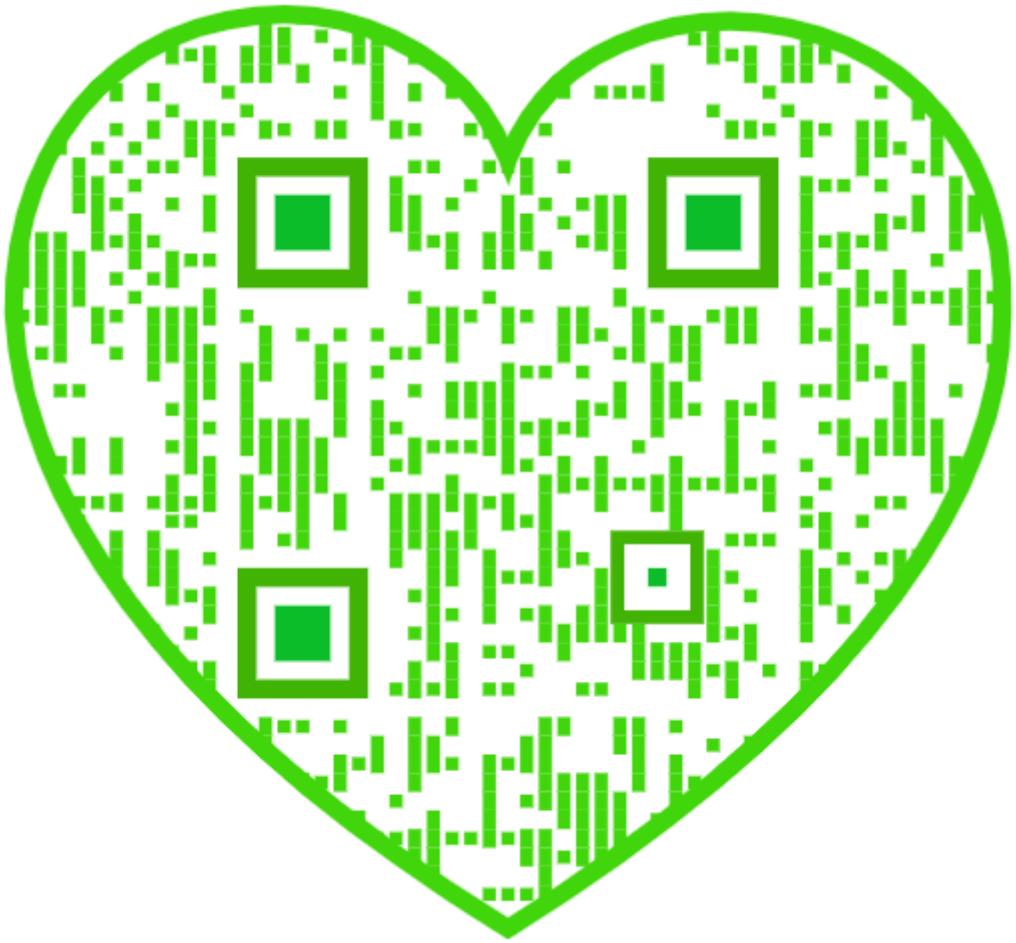

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Contents.

(Illustrated articles are marked with an asterisk.)

Bakers' implement, Mr. Landrith's*..... 82
Belts; friction of, etc..... 85
Chlorine..... 89
Concrete, uses of in Jamaica..... 81
Cotton, silkified..... 82
Dam, great, Beetaloo, Australia*. 86
Electrical observations two miles high..... 86
Electricity, cable speed of..... 83
Engine, marine, rapid fitting..... 83
Engineer's license for a woman.. 83
Face, growth of the..... 89
Fire escape, Vieregg's*..... 82
Garnets and peridots..... 85
Gas, natural, the law of..... 89
Gums, resins, and balsams..... 85
Horse, the speed of a..... 80
Immigration during seventy years..... 83
Inventions, recently patented.... 90
Iron, volatilization of..... 88
Jet propulsion..... 85
Locomotive cylinders, two in one 89
Microscopists, American Society of..... 83
Massage, a book upon..... 91
Nitrate of soda..... 80
Patent law, new German..... 88
Patent rights and wrong..... 88
Patent system, the British..... 88
Patents, classifications of applications for..... 81
Phosphoric acid, pure..... 83
Pile driving by jets..... 84
Plants, economic, government collection of..... 80
Railway collision, Illinois Central Railway*..... 83
Railway, ship, the Chignecto..... 87
Refrigerant, a new..... 83
Snakes, characteristic poises of*.. 87
Snakes, habits of..... 81
"Staff" for World's Fair buildings..... 84
Steel, German deceptions in..... 84
Tunnel under the Thames, another..... 87
Type writing machine, Edland's* 82
Vehicle spring equalizer, Foster's*84
Water supply system, new, Newark, N. J.*..... 79

TABLE OF CONTENTS OF

SCIENTIFIC AMERICAN SUPPLEMENT

No. 814.

For the Week Ending August 8, 1891.

Price 10 cents. For sale by all newsdealers

PAGE

I. ARCHITECTURE.—The London Eiffel Tower.—The design as chosen definitely for the great tower in London..... 12999
II. BIOGRAPHY.—Silva Jardim.—Geographical note, with portrait of a victim to Vesuvius.—1 illustration..... 13009
III. BOTANY.—Mandioca.—By THOMAS MORONG.—A full description of the plant, its cultivation and uses and its poisonous property..... 13011
Potato Perforated by Couch.—A curious instance of a root penetrating the tuber of a potato plant.—1 illustration..... 13011
IV. CHEMISTRY.—The Conversion of Starch into Dextrine.—By A. VILLERS.—The easy conversion of starch by the cultivation of a bacillus..... 13012
The Electrolysis of Sulphuric Acid.—Further information upon the new peroxide of sulphur obtained by electrolysis..... 13014
Oils of Lemons, Limes, etc.—By ARTHUR A. BARRETT.—The chemistry of these well known flavoring oils, their properties and distinctions..... 13013
V. CIVIL ENGINEERING.—Leading Engineering Works of the Past Year.—By O. CHANUTE.—A very valuable paper describing the great achievements of the past year in the engineering world. 13002
Wooden Bridge over the River Barrow.—A bridge erected upon a new principle, with full description.—2 illustrations..... 13001
VI. ELECTRICITY.—De Lalande's New Oxide of Copper Battery.—A new agglomerate battery, description of its manufacture and details of its mounting.—4 illustrations..... 13006
Pocket Electrometers.—By C. V. BOYS.—Small size electrometers depending on quartz fibers for suspension.—A very ingenious contribution.—3 illustrations..... 13005
Tanning by the Aid of Electricity.—By Dr. S. RIDEAL and A. P. TROTTER.—An elaborate review of this much discussed subject, giving the result of a full research into its history and practicability..... 13006
The Electrolytic Preparation of Chlorate of Potassium..... 13005
The Edison Patent Decision.—A *resume* of Judge Wallace's decision in the incandescent electric lamp suit..... 13005
VII. FORESTRY.—The Red Oak.—A description of one of the largest and most beautiful deciduous trees of America..... 13011
The Great Douglas Spruce.—A great lumber tree of the Western and Northwestern coast fully described, with its habits..... 13012
VIII. MICROSCOPY.—Common Objects Available for Exhibiting the Power of the Microscope.—By F. BLANCHARD, M.D.—A suggestion of common objects available for use upon the microscopic stage..... 13010
IX. NAVAL ENGINEERING.—Jet Propulsion.—A contribution to this interesting subject, with a discussion upon the same by different engineers.—1 illustration..... 12999
Note on Recent French Torpedo Boats..... 13000
The Royal Mail Steamer Scot.—A new Clyde built ship of high speed, to ply between England and South Africa.—1 illustration.. 13000
Slip for the Broadwise Docking of Ships.—A marine railroad for raising ships laterally.—3 illustrations..... 13002
X. PHOTOGRAPHY.—A Photographic View and the Human Eye.—A very interesting comparison between the photographic review and the binocular and monocular fields of vision of the human eye.—1 illustration..... 13010
XI. PHYSICS.—The Aberrations of Sound.—An attempt to generalize the conditions of propagation of sound waves with regard to its inaudibility in certain regions.—1 illustration..... 13010
XII. PHYSIOLOGY.—Uric Acid in Diseases of the Nervous System.—The role played in this class of diseases by uric acid, and how its excretion can be controlled..... 13010
XIII. TECHNOLOGY.—Lavender—Its Cultivation and Distillation.—By J. C. SAWYER.—The distillation of oil of lavender.—Its rectification and tests for purity, with the cultivation of the plant.—1 illustration..... 13013

THE GOVERNMENT COLLECTION OF ECONOMIC PLANTS.

The collection of economic plants in the grounds of the United States Department of Agriculture at Washington embraces many rare and curious varieties, and it is well worthy of a visit and of careful study. A portion of these plants are intended for distribution in sections of the country adapted to their growth; but the principal object in maintaining the collection is to provide an educational museum of select economic plants, the products of most of which are familiar to many people, while few may have seen the plants themselves.

The plants have been procured, most of them, from botanic gardens throughout the world, while others have been raised from seeds procured from their native countries. The collection is kept in glass structures in atmospheres suited to their respective requirements, and the localities in this country where they will thrive the best is thus ascertained.

Almost every plant in the collection has interesting characteristics, and all have a special value for the srudent of botany, because they are very rarely met with in this country. A few specimens are here described, which will be a fair indication of the character of this most valuable collection.

Abrus precatorius.—Wild licorice. This twining, leguminous plant is a native of the East, but is now found in the West Indies and other tropical regions. It is chiefly remarkable for its small oval seeds, which are of a brilliant scarlet color, with a black scar at the plate where they are attached to the pods. These seeds are much used for necklaces and other ornamental purposes, and are employed in India as a standard of weight under the name *rate*. The weight of the famous Kohinor diamond is known to have been ascertained in this way. The roots afford licorice, which is extracted in the same manner as that from the true Spanish licorice plant, the *Glycyrrhiza glabra*. Recently the claim was made that the weather could be foretold by certain movements of the leaves of the plant, but experimental tests have proved its fallacy.

Adamsonia digitata.—This is the baobab tree, which is a native of Africa. It has been called the tree of a thousand years, and Humboldt speaks of it as "the oldest organic monument on our planet."

Adamson, who traveled in Senegal in 1794, made a calculation to show that one of these trees, 30 feet in diameter, must be 5,150 years old. The bark of the baobab furnishes a fiber which is made into ropes and also manufactured into cloth. The fiber is so strong as to give rise to a common saying in Bengal, "As secure as an elephant bound with the baobab rope." The pulp of the fruit is slightly acid, and the juice expressed from it is valued as a specific in putrid and pestilential fevers. The ashes of the fruit and bark boiled in rancid palm oil make a fine soap.

Agave americana.—This plant is commonly known as American aloe, but it is not a member of that family, as it claims kindred with the Amaryllis tribe of plants. It grows naturally in a wide range of climate, from the plains of South America to elevations of 10,000 feet. It furnishes a variety of products. The plants form impenetrable fences, the leaves furnish fibers of various qualities, from the fine thread known as pita thread, which is used for twine, to the coarse fiber used for ropes and cable. Humboldt describes a bridge of upward of 130 feet span over the Cimbo in Quito, of which the main ropes, 4 inches in diameter, were made of this fiber.

It is also used for making paper. The juice, when the watery part is evaporated, forms a good soap, as detergent as castile, and will mix and form a lather with salt water as well as with fresh. The sap from the heart leaves is formed into pulque. The sap is sour, but has sufficient sugar and mucilage for fermentation. This vinous beverage has a filthy odor, but those who can overcome the aversion to this fetid smell indulge largely in the liquor. A very intoxicating brandy is made from it. Razor straps are made from the leaves, and they are also used for cleansing and scouring pewter.

Antiaris intoxia (*the Upas Tree*).—Most exaggerated statements have passed into history regarding this plant. Its poisonous influence is said to be so great as not only to destroy all animal life, but even plants could not live within ten miles of it. The plant has no such virulent properties as the above, but, as it inhabits the low valleys of Java, where carbonic acid gas escapes from the crevices in volcanic rocks, which frequently proves fatal to animals, the tree was blamed wrongly. It is, however, possessed of poisonous juice, which, when dry and mixed with other ingredients, forms a venomous poison for arrows, and severe effects have been felt by those who nave climbed upon the branches for the purpose of gathering the flowers.

Brosimum galactodendron.—The cow tree of South America, which yields a milk of as good quality as that from the cow. It forms large forests in the mountains near the town of Cariaco and elsewhere along the seacoast of Venezuela reaching to a considerable height. In South America the cow tree is called *Palo de Vere* or *Arbal de Leche*. Its milk, which is obtained by making incisions in the trunk, so closely resembles the milk of the cow, both in appearance and quality, that it is commonly used as an article of food by the people of the places where the tree is abundant. Unlike many other vegetable milks, it is perfectly wholesome, and very nourishing, possessing an agreeable taste, and a pleasant balsamic odor, its only unpleasant quality being a slight amount of stickiness.

Cereus gigantia.—The suwarrow of the Mexicans, a native of the hot, arid and almost desert regions of New Mexico, found growing in rocky places, in valleys and on mountain sides, often springing out of mere crevices in hard rocks and imparting a singular aspect to the scenery to the country, its tall stems often reaching 40 feet in height, with upright branches looking like telegraph poles for signaling from point to point of the Rocky Mountains. The fruits are about two to three inches long, of a green color and oval form; when ripe, they burst into three or four pieces, which curve back so as to resemble a flower. Inside they contain numerous little black seeds embedded in a crimson colored pulp, which the Indians make into a preserve. They also use the ripe fruit as on article of food.

Dracæna draca.—The dragon's blood tree of Teneriffe. This liliaceous plant attains a great age and an enormous size. The resin obtained from it has been found in the sepulchral caves of the Cuanches, and hence it is supposed to have been used by them in embalming the dead. Trees of this species still in vigorous health are supposed to be as old as the pyramids of Egypt.

Mauritia flexuoso.—The Moriche, or Ita palm, very abundant on the banks of the Amazon, Rio Negro, and Orinoco Rivers. In the delta of the latter it occupies swampy tracts of land, which at times are completely inundated, and present the appearance of forests rising out of the water.

These swamps are frequented by a tribe of Indians called Guaranes, who subsist almost entirely upon the product of this palm, and during the periods of the inundations suspend their dwellings from the tops of the tall stems. The outer skin of the young leaves is made into string and cord for the manufacture of hammocks. The fermented sap yields palm wine, and still another beverage is prepared from the young fruits, while the soft inner bark of the stem yields a farinaceous substance like sago.

Papyrus antiquorum.—The paper reed of Asia, which yielded the substances used as paper by the ancient Egyptians. The underground root stocks spread horizontally under the muddy soil, continuing to throw up stems as they creep along. The paper was made from thin slices, cut vertically from the apex to the base of the stem, between the surface and the center. The slices were placed side by side, according to the size required, and then, after being wetted and beaten with a wooden instrument until smooth, were pressed and dried in the sun.

The collection of economic plants contains specimens of the bread fruit trees from South America, camphor trees from the island of Formosa, the South American trumpet tree, whose hollow branches are used for musical instruments, the tree from which the famous Peruvian barks are obtained, and many others equally interesting.

The Speed of a Horse.

While the public is still marveling over Salvator's wonderful performance in running a mile in 1·35½, there are few who have, through comparison and analysis, sought to realize what a terrific burst of speed this is. It is nearly forty miles an hour—a rate averaged by very few of our fastest railway trains. There are 5,280 feet in a mile, so that for every one of these ninety-five seconds—for every beat of a man's pulse—this wonderful horse covered fifty-five and three-tenths feet of ground. The shortest space of time noted by the turfman's watch is a quarter of a second—an interval so brief that the eye can hardly observe, the mind can hardly appreciate it. Yet in every one of those 382 quarters of a second that magnificent creature leaped sixteen and three-tenths feet. Such are the amazing results of careful breeding as exhibited in the American race horse.

Nitrate of Soda.

No manure that I have ever seen used, not even cow manure, in which I have great faith, has produced such immediate effect in the growth, vigor, and full color of foliage. Mr. J. J. Willis, writing in the *Gardeners' Chronicle*, maintains that it is a most valuable factor in the production of vegetable crops and fruits. He strongly recommends it for strawberries, celery, cabbages, onions, in fact, for all kitchen garden produce. But he recommends it to be used in conjunction with ordinary manures. He says: "It may be stated that nitrate of soda is not regarded as a substitute for other manures. Taking horticulture as we find it, we recommend nitrate of soda as the cheapest and best form in which to apply nitrogen to plants. To those who are using ordinary stable manure we say, continue to use it, but use nitrate of soda in addition."—*W. Watson, in Garden and Forest.*

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HABITS OF SNAKES.

We publish elsewhere an article by Mr. G. R. O'Reilly, of the Royal Zoological Society of Ireland, who has recently come to this country after extensive travels through the wilds and jungles of South Africa, South America and the West Indies. He has been traveling in search of snakes and reptiles, with the view of studying their nature, and he has formed a large and interesting collection, which he has brought with him to this country. With his kind assistance we have procured some interesting instantaneous photographs of the position assumed by some of the more characteristic varieties of snakes when coiled either in sleep or in anger. Each picture is a study from life and an exact reproduction from nature.

The coils of many snakes when in repose and when on the defensive are exactly similar, and it is very difficult to tell whether or not a snake is asleep, from the fact that the eyes seem always open. They are closed by drawing the epidermis like a film over the eye, but no external change is perceptible to the casual observer. If the engraving of the fer de lance is examined, it will be observed that there are two black spots on the head that appear to be eyes, but a more careful examination will reveal the true eyes higher up in the head and quite separated from each other. The black spots are "the pits" or hollows in the sides of the snout, and, strange to say, their function is a mystery to the naturalist.

Mr. O'Reilly handles the snakes with freedom, although the greatest care must be observed in handling such venomous serpents as the labarri, the rattler, the moccasin, or the fer de lance. In collecting snakes he simply uses a long pole with the end bent at an angle of about 45°.

This is laid over the back or neck of the victim, and when once he is firmly pinioned to the ground, the hunter gradually approaches and seizes him about the back of the neck. Once firmly held in his grasp, the snake is thrown over the shoulder, and the prisoner is allowed to coil about pretty much as he chooses. Care must be taken not to allow the grip on the neck to be relaxed or there will be trouble. None of the snakes in this collection has been mutilated by the extraction of the fangs.

As stated elsewhere, the labarri is one of the most subtile and deadly of serpents. Fearless, he will not retire before the approach of man, and will strike with deadly aim and without warning. Our rattlesnake seems almost harmless in comparison, as many a life has been saved by the unintentionally friendly signal of warning.

The object of the rattle has always been a puzzle to the naturalist. It is hardly to be conceived that Providence, that is so kind in providing various living creatures with weapons offensive and defensive, should have furnished the rattler with an organ for warning off the very objects of its prey. Nor is it natural to suppose that it would still cling to a habit that apparently has lost him many a dinner. This is explained partly, perhaps, by the fact that the rattling is almost always the nervous vibration of the tail, caused by fear or anger, which movement is characteristic also of the labarri, the fer de lance, and other varieties, as explained elsewhere. Of course with the latter no sound is produced.

It is doubtful whether the rattle comes into play ordinarily, when the reptile is in search of food, unless he is suddenly startled or disturbed. During the very wet seasons, the rattles sometimes become soaked with water, and no sound is given out. At such a time he is particularly dangerous. Furthermore, in the tropics insects of the cicada kind are frequently found whose characteristic sound is so similar to that of the rattler that the warning of the latter is of little avail, as it is lost as a signal in the confusion of noises that fill the forest.

Uses of Concrete in Jamaica.

I was in the island of Jamaica a few months ago, where there is very little, if any, good building stone, and concrete is used to a very large extent.

The Jamaica Railway Company were then building an extension of their line, and I was invited to examine the works. Away up in the mountains they were building concrete pipe culverts, of 4 feet diameter and over, and they were doing it in a very successful way. I was much interested to see how easy it was to do what with us at home has generally been considered not feasible. Here, when we use pipe culverts for railroad work, we usually employ extra heavy earthen sewer pipe or cast iron pipe, either of which is costly, and often difficult of transportation, but there they were easily and swiftly building the culverts right at the site. They had a portable platform which could be brought quite near, on which were ranged a number of spacing blocks conforming to the circumferences of the inner and outer frames of cylindrical wooden moulds. The frames were placed vertically on the platform, secured firmly at the bottom by the spacing blocks, and clamped together at the top, the proper gauge being maintained by double wedges between the two halves of the inner frame; the concrete, composed of cement, sand, and gravel, was poured in and rammed. After sufficient time had been allowed, the wedges were removed, and the inner frame taken out, just as centers are struck, and then the outer frame could be lifted off. The same platform could, of course, be used for various sizes and several sections of pipe at one time, and could readily be moved along from place to place; although the whole operation was being performed by negro laborers, there was nothing wanting either in strength or smoothness of the finished pipes. If I remember correctly, they had a rough rule of 1 inch thickness of pipe for each foot of diameter. The ease and cheapness with which the cement can be transported, compared with manufactured pipe, would recommend this form of construction, even if the actual first cost of material also was not less; in this case the chief cost was in the cement, sand and gravel being generally found close at hand.

I was also shown a very heavy retaining wall, 20 feet or more in height, on the concave side of a sharp bend of the River Cobra, built to support the railway embankment where exposed to the full effect of formidable freshets; the wall was entirely of concrete from toe to coping, and had been in service for several seasons with absolute perfection.

Concrete is used in Kingston for architectural purposes to an extent we do not dream of here. They use it for arches, retaining walls, colonnades, the walls of houses, stairways, of which the entire structure of supporting members and treads is a homogeneous body of fine concrete, and, generally speaking, wherever we would use stone; the quality is very strong, hard, and enduring.—*J. Foster Crowell, Trans. Am. Soc. Civil Engineers.*

The Classification of Applications and Patents in the United States Patent Office.

Under the patent law of the United States, a thing to be entitled to protection by letters patent must be new and must possess invention.

Most things which are new are the result of the exercise of the inventive talents, and are therefore patentable.

To determine the novelty of a device for which a patent is solicited, and hence the patentability of the same, it is provided by statute that the Commissioner of Patents shall cause an examination to be made of all previous patents relating thereto, or, as it is commonly termed, of the "state of the art."

This examination, when completed, is supposed to remove all doubts as to the novelty of the thing in question and to determine its patentability.

This examination, to be thorough, depends upon two things—the skill and honesty of the members of the examining corps and a proper classification of inventions.

A proper classification should be of such a character that the officer whose duty it is to assign applications for examination may be able to determine, by a careful inspection thereof, its proper place in the arts and to what class and division it should be assigned.

While the classification now in vogue is conceded by all to be the best which has yet been devised, to any one who has carefully considered the matter it must be apparent that it has many defects and is open to improvement in many particulars.

Under this classification, applications and inventions are assigned for examination with relation to the particular specific art to which they are more closely allied.

Those inventions relating to the manipulation of metal are sent to the class of metal working; those relating to the mechanical treatment of paper to the class of paper manufactures; those relating to the treatment of leather to the class of leather working, and so on throughout the office.

An application for a patent for a machine for rolling sheet metal is assigned to the division of metal working; one for ironing cloth is sent to textiles, while one for ironing or rolling leather is sent to leather working, notwithstanding that in most cases these machines are analogous in construction and operation and can be interchangeably used.

As the courts have decided that an inventor is entitled to all the uses to which his invention can be put, a machine which has once been patented for one purpose cannot be again patented for another purpose. A machine for rolling metal or cloth can generally be used for rolling leather.

Under the present classification, these three classes of machines are in three different divisions of the office, so that to be certain that a machine of one of the classes is new, a search therefor must be carried on in each of the respective classes or divisions wherein the others are classified.

These classes are in different rooms in the Patent Office and are widely separated, on different sides and different floors of the building, so that an examiner who may be prosecuting a search for a machine of the kinds mentioned must tramp around the office from room to room and floor to floor of this great building in order to make a thorough search, consuming much valuable time in his pilgrimages, and, perhaps, being unfamiliar generally with classes other than his own, his search is rendered difficult and uncertain.

This classification undoubtedly lends an air of uncertainty to the search and to the novelty of many things, for if the examiner be a recent employe, and be therefore ignorant of the existence of analogous classes, or if he be careless, and thus through ignorance or carelessness fails to make an examination therein, duplicate patents are liable to be, and as a matter of fact are, granted.

Fortunately, the members of the examining corps are generally capable and painstaking men, who are alert and careful in the performance of their duties, protecting equally the interests of the inventor and the public, and to this fact is due the very few duplicate patents in the many thousands issued yearly.

Another defect in the present classification, and one which cannot be too strongly condemned, is the facility with which an applicant or his attorney can practically determine in what class his invention shall be examined and to locate the same therein.

The assignment of the application is, in most cases, determined by the title which is given the alleged invention or the statement of invention contained in the specification.

Let us assume, for an example, that a man has invented a machine for cutting fabric, either cloth, leather, or paper, and for some reason he desires this machine to be examined in the class of paper manufactures.

There are many reasons why he may desire this; he may be in a hurry to get an action on his case and this division may be farther advanced in date than another, or the examiner in this class may be known to have more liberal views than another; in this case, he simply styles his machine a machine for cutting paper, when his object is obtained, the case is assigned where he wants it to go. The same is true throughout the office. A machine for riveting sheet metal is assigned to metal working, but the same machine, if called simply a riveting machine, and the statement of invention should set forth that it was adapted to insert rivets in *leather* and other sheet material, would be assigned to the class of leather working.

Under the present classification, one division patents knives; another patents hay knives; another shoe knives; another woodworking knives, and still another knife erasers—five separate divisions granting patents for knives.

There are at least three divisions patenting tacking and nailing machines, differing only in the material into which they drive the tacks or nails.

There are at least three divisions patenting chains, links, etc.

Is there any wonder that duplicate patents are sometimes granted?

The remedy for this state of affairs lies in the adoption of a classification which shall classify according to mechanical constructions and the generic functions of machines and devices.

Thus machines for *cutting* fabric, whether cloth, leather, or paper, would, under this classification, all be assembled in one division or class. All riveting machines, no matter upon what material they operate; all knives; all pegging and nailing machines; all rolling machines; and all chains, would be classified under their respective generic classes, such as cutting machines, riveting machines, nailing machines, knives, chains, etc.

This classification would result in the grouping of inventions of analogous constructions and generic functions in a single division of the office and would reduce to a minimum the possibility of issuing duplicate patents. This would arise from the fact that, these generic devices all being in one division, the examiners would become more familiar with them, resulting in more certain and thorough examinations being made.

The time now spent by the examiners running around to many different divisions would be saved and utilized in the work of examining, thus materially aiding the advancement of the work of the office.

Of course it is realized that it would be almost impossible to devise a classification which would entirely do away with the overlapping of the classes, but the one suggested, it is thought, would reduce such overlapping to a very small per cent.

A change must at some time be made, for it is becoming more difficult every year, with the enormous increase in the issue of patents, to make thorough examinations.

It is realized that any change must necessarily be made gradually, in order not to greatly interfere with the work of examination; but with a competent force it could be done in a comparatively short time without retarding the work of the office. T. H. A.

THE magnetic needle points in the same direction as to the magnetic poles in all parts of the earth. The magnetic poles do not correspond with the axis of the earth, which makes a variation of the needle at places not on a meridian which coincides with both poles. The needle is never inverted, but dips as it approaches the magnetic poles.

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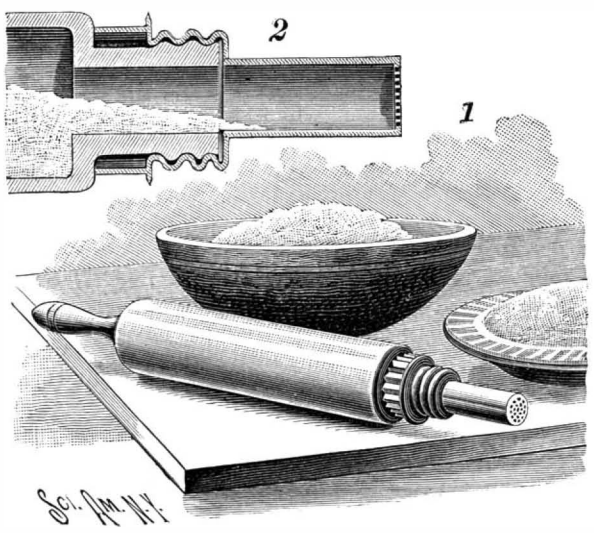
A ROLLING PIN, ETC., FOR BAKERS' USE.

A rolling pin with which is separably combined a cake cutter, pie crimper and edge dresser, and a dredge box or sifter for flour, forms the subject of a patent which has been issued to Mrs. Jane L. Landrith, of Marshfield, Oregon. The device is shown in perspective in Fig. 1 and in longitudinal section in Fig. 2. One end of the rolling pin has a handle formed integral with the body in the usual style, and the main portion is hollow, forming a capacious flour receptacle. The opposite end has a reduced screw-threaded hollow extension, designed to receive and removably retain a threaded handle piece, preferably of tin, having an outer perforated cap plate, through which flour may be sifted from the central chamber. A radial thin flange is formed at the inner edge of the threaded portion of the handle piece, to which is affixed a fluted



MRS. LANDRITH'S ROLLING PIN, ETC., FOR BAKERS.

short band or ring. The cylindrical portion and one handle of the utensil are preferably made of glass, as a cool and non-absorbent material which does not retain the dough, to trim the excess of which from the edge of a pie plate the handle piece is removed and its thin flange used to cut off the surplus, the fluted ring at the same time impressing or crimping the edge of the pie. This fluted ring is also adapted to cut cake dough that has been rolled to the proper thickness, forming a serrated edge.

A SIMPLE AND COMPACT TYPE WRITER.

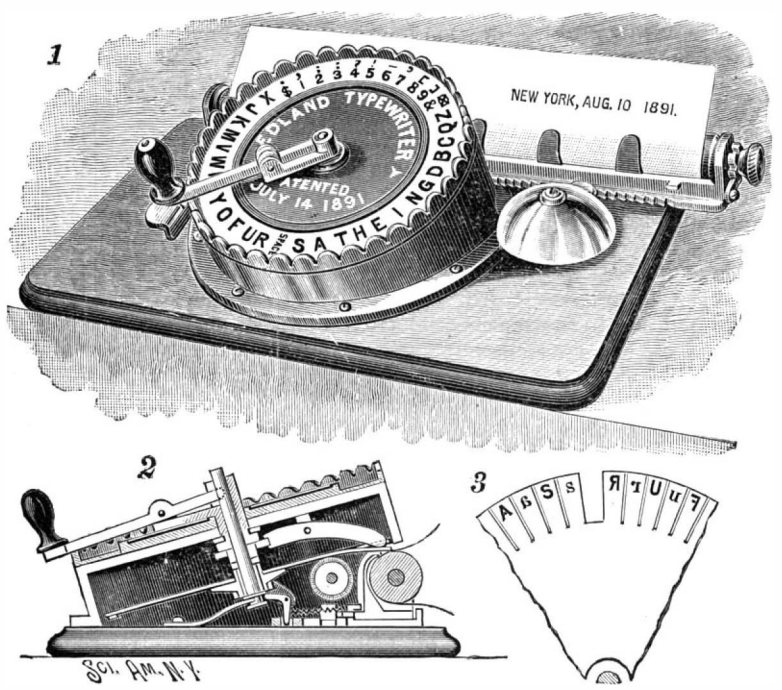
The machine shown in the illustration can be readily operated by one not familiar with type writing, and is specially adapted for the individual or private use of those not employing professional type writers. It can be made at a low cost and is very compact, its base being only about five by nine inches in size, and the dial plate about four inches in diameter. Fig. 1 is a view of the machine in perspective and Fig. 2 is a central vertical cross section. The paper carriage at the back has a flat lower portion which moves in keepers on the base, and has a rack on its inner side which is engaged and moved by a spring pawl, the notches on the rack each corresponding to a letter space.

In the carriage is mounted a rubber roll which serves as a feed roll and a printing platen, the roll having a thumb piece at one end by which it is revolved, and a ratchet preventing backward movement, while the front upper portion of the roll is loosely clasped by flat springs secured to the carriage, to hold the paper in position and allow it to be fed forward.

Fixed centrally on the base to overlap the paper carriage and roll is an inclined drum, surmounting which is a dial with a notched flange bearing the various characters to be printed, the notched flange serving as a guide to the printing lever, and causing it to descend accurately for each character. Within the drum near the top is a three-armed spider, and below is a central cross arm, both centrally perforated to receive a vertically movable shaft. A central vertical tube has a slot near the top, beneath which extends an arm having lugs at its end, between which is pivoted the printing lever, the inner end of which is connected with a vertical shaft extending downward through the tube. Fixed to the lower end of the tube, and necessarily revolving with it, is a wide flanged hub, carrying an annular plate, the outer portion of which is slit radially to form flexible type fingers, carrying type or characters on their under sides near their outer ends, the upper and lower case type of each letter being produced on alternate fingers, a portion of this plate being shown in Fig. 3.

A sleeve moves vertically on the tube and is held to the shaft by a pin, moving vertically with the latter and revolving with the shaft and tube. Pivoted between lugs on the under side of the spider, as shown in Fig. 2, is a curved lever, whose inner end is slotted to clasp a flange on the sleeve, while its outer end extends to the outer ends of the flexible type fingers, so that when the sleeve is raised by the depression of the printing lever the outer end of the curved lever is depressed, causing a character to be printed upon the paper by the flexible type finger immediately beneath. The central shaft and the printing lever are returned to normal position by a spring, one end of which is fixed to the base, while its opposite end engages flanges on the bottom of the shaft. An elbow lever pivoted on the base and a similar lever pivoted on the cross arm of the drum are so arranged, in connection with a spring, that each depression of the printing lever causes the paper carriage to move the distance of one notch, or the space of a letter. When the printing lever is held down the carriage may be freely moved backward to position for commencing a new line. Although the dial shown in the illustration bears only upper case type, it is to be remembered that there are alternate upper and lower case type fingers, the latter being those normally employed, but on depressing a thumb piece shown at the left in the picture, upper case characters will be printed. Ink rollers are pivoted on the inner sides of the drum, in the path of the type on the fingers. This machine has comparatively few pieces, so that it will not readily get out of order, and for its operation it is only necessary to place the paper in position, bring the printing lever above the characters to be printed, and press down on the lever.

This type writer has been patented by Mr. Joe L. Edland, of No. 73 Fourth Avenue, Brooklyn, N. Y.



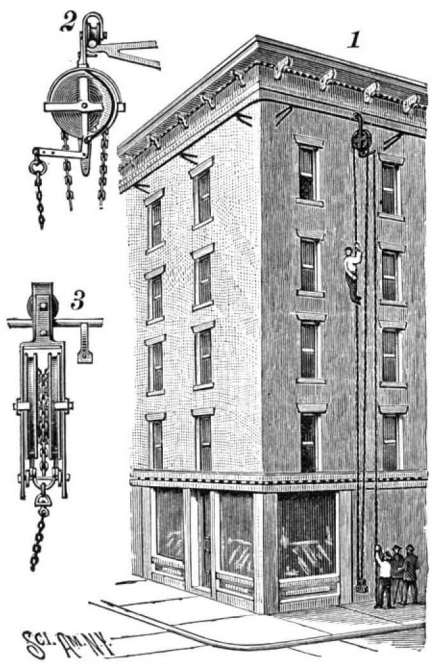
EDLAND'S TYPE WRITING MACHINE.

Silkified Cotton.

The invention of C. Brodbeck, Paris, consists in applying a solution of fibroine of silk to fabrics, threads, or fibers which have been scoured, lixiviated, and bleached, and the tissues calendered by friction and beetled. They are then hydrated and physically modified by passing them through a solution of caustic potash or soda of 1·35—1·40 sp. gr., or of sulphuric acid of 1·53—1·56 sp. gr. In both cases a low temperature of 4°—8° C. is required. If animal fibers are present, no caustic alkalies can be used. Cellulose is by this treatment freed from most of the impurities which it contains when imperfectly bleached, which renders the fixing of the silk easier and more perfect. After careful washing and drying the fabrics or fibers are treated with concentrated solutions of silk, the fibroine being dissolved either in hydrochloric, phosphoric, or sulphuric acid, or in pure cuprammonium, etc. If the solution of silk is effected in more or less hydrated sulphuric acid, the temperature must be about 0° C., to avoid decomposition. Silk in any form may be dissolved; hence scraps, cocoon silk, waste silk, and other material which was hitherto practically useless may thus be utilized. Previous to silkifying cellulose fabrics they should be subjected to the action of a metallic or tannic mordant, the selection of which depends on the color which the fabric is to receive. This is of advantage in combining the silk more intimately with the cellulose. The impregnation with the silk solution is effected by passing the material through a tightly closed impregnating apparatus with only two openings, one for the inlet and the other for the outlet of the material. It then passes through a hot air drying apparatus, and subsequently through a second vessel containing liquids with which the solvents employed combine, the silk being thereby precipitated upon and fixed in the pores of the fibers. The material is then washed and dried. Should it be desired to increase the amount of silk, the silkifying process may be repeated as often as desirable. Materials rendered silky in this way may be bleached by the same means as those employed for real silk. All fabrics which have been treated by this process must be subjected to a mechanical finishing, beetling, calendering, rubbing, brushing, polishing, and pressing according to the purpose for which they are destined, in order to impart to them a glossy appearance and silky feel.

AN IMPROVED FIRE ESCAPE.

A device, capable of being expeditiously manipulated, to lower persons in safety from the upper floors of high buildings to the ground, is shown in the accompanying



VIEREGG'S FIRE ESCAPE.

illustration, and has been patented by Mr. Henry Vieregg, of Grand Island, Neb. A public test was recently made of this device on a high building at Grand Island, with results so entirely satisfactory that its merits were made the subject of a special testimonial, which was signed by the mayor and chief officials, engineers and members of the fire department, and many prominent citizens.

The body of the device consists of a drum mounted to turn in a frame, an upwardly extending member of which has a hook or loop extension carrying a grooved pulley, as shown in Fig. 2, the pulley being adapted to travel on a track held in brackets beneath the cornice of the building, and being prevented from leaving the track by a pin projecting horizontally beneath the track from the upper member of the frame. A guide frame is horizontally secured to the frame, the lower ends of the sides of which are united by a bar, and the drum is journaled at the intersection of the guide frame with the side pieces of the main frame. The drum has marginal flanges and two spaced central flanges, forming a central annular channel of reduced diameter, in which is passed an endless chain, as shown in Fig. 3, cleats or studs projecting into this channel from the side flanges to engage some of the links of the chain and prevent its slipping upon the drum. The chain is designed to reach nearly to the ground, where it passes around a pulley journaled in a heavy block, having a handle, whereby parties on the ground may draw the chain outward to facilitate the safe descent of parties from a building, such descent being made by simply gripping the chain, or any approved form of harness may be employed to be hooked to the chain links. To control the descent, strap brakes are employed, engaging the larger sections of the drum between the marginal flanges at each side, the lower ends of the straps being connected with the inner ends of levers pivoted on the lower cross bar of the frame, the outer ends of the levers being connected by an adjustable bail with a ring and swivel, from which a brake chain depends. By this means the brakes may be applied by the party descending, or by one upon the ground below, to regulate as desired the speed of descent.

THE enormous mass of extra dead weight due to the carrying of the boiler, fuel and water in the old locomotive will be entirely unnecessary in the railways of the future, which will be propelled electrically. Unquestionably the future electro-locomotion will show a motor on every axle, or, at any rate, upon two axles of each car, and every car running as a unit, in which case they can run coupled together in a train or not, as may be convenient.—*Philadelphia Press.*

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Pure Phosphoric Acid.

A known quantity of pure calcium phosphate is gradually added to a slight excess of pure dilute hydrofluoric acid, contained in a leaden or platinum vessel, the mixture being well stirred after each addition. According to the *Compt. Rend.*, an energetic action takes place and considerable heat is evolved. When all the calcium phosphate has been added, the high temperature of the mixture must be maintained for some time in order to complete the reaction. After the removal by filtration of the calcium fluoride which is formed, the solution of phosphoric acid is evaporated. At the point when the solution commences to become viscid, the excess of hydrofluoric acid used is volatilized. The evaporation is continued until a thick sirup, containing 60 to 70 per cent of phosphoric anhydride, is obtained. Meta and pyrophosphoric acids may be prepared by further continuing the evaporation and heating.

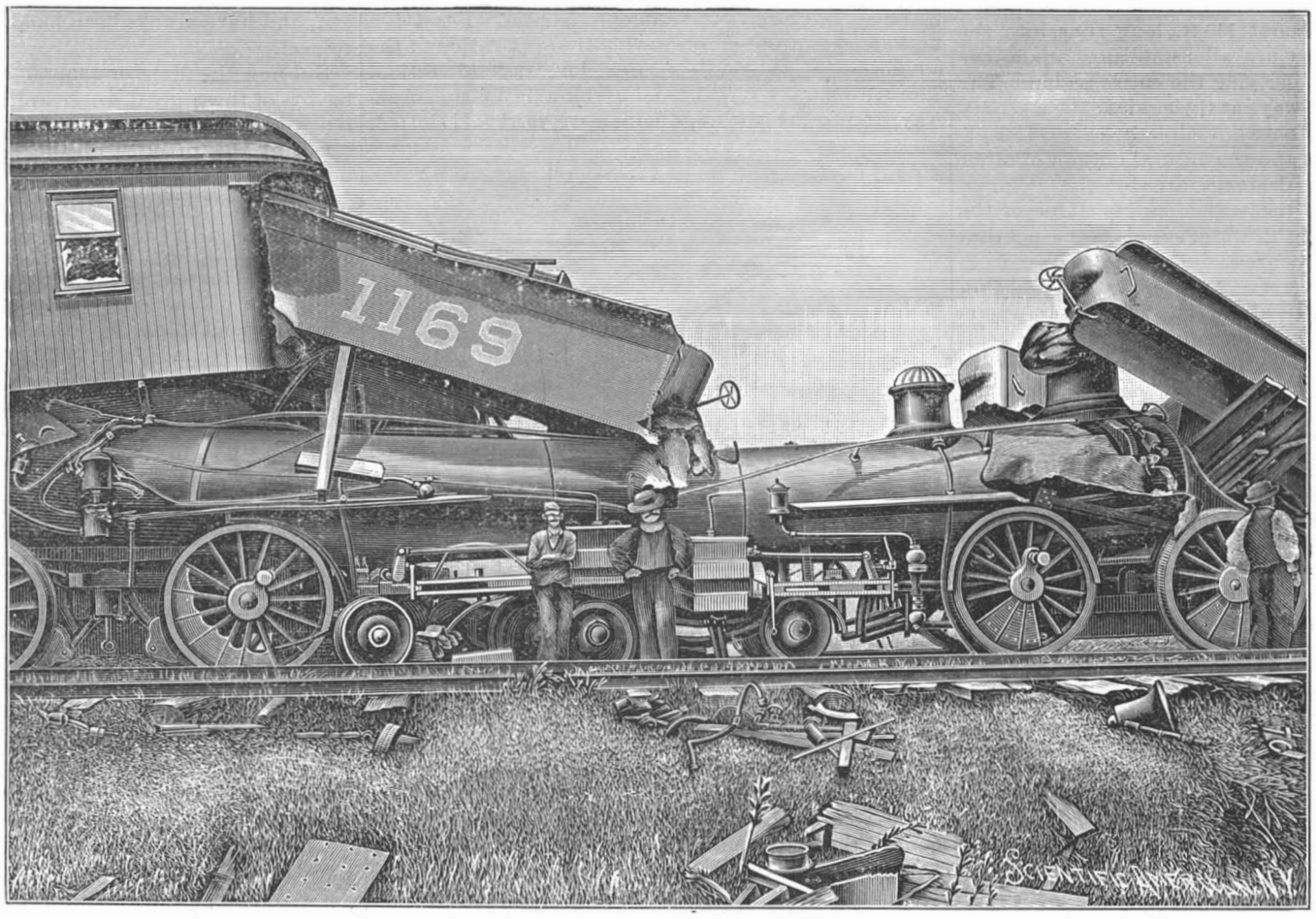
The various calcium salts of phosphoric acid described by Erlenmeyer may be readily prepared by adding hydrofluoric acid to a large excess of calcium phosphate, and after mixing well, dissolving out with warm water the acid salts produced. Impure phosphates, such as bone ash, may be used for the preparation of phosphoric acid, provided that the resultant acid, after being evaporated to carbonize the organic matters present, is diluted with water, filtered and again evaporated.

RAILWAY COLLISION, ILLINOIS CENTRAL RAILWAY.

Our engraving is from a photograph of a pair of locomotives on the Illinois Central Railway as they appeared after a collision. Four persons were killed and six injured. The New Orleans *Picayune* says: "At 9:45 on the night of June 19, 1891, the north bound mixed freight train on the Illinois Central Railway sidetracked at Savage station, about five miles from the city, in order to give the south bound cannon ball passenger train a clear track. By some unaccountable means the switch was left open and the passenger train, going at full speed, dashed into the freight train, derailing all of the cars except the sleepers.

"The cars telescoped, the mail car being thrown on top of the two engines, which were total wrecks. Engineer Mitchell, of the passenger train, was fatally injured, and both firemen, Munn and Lawson, one white and one colored, were instantly killed, being jammed between two boilers."

The two locomotives came together with such force that they appeared to be welded together.



RAILWAY COLLISION, ILLINOIS CENTRAL RAILWAY.

Rapid Marine Engine Fitting.

A smart feat of engineering has been performed at the Central Marine Engine Works, West Hartlepool, England, in the rapidity with which the screw steamer Silvia has been fitted with her machinery. The vessel was launched about 4:30 P. M., on Tuesday, June 23, from Messrs. Irvine's shipyard, and proceeded under the sheerlegs at the Central Engine Works. The engines, which are of 500 indicated horse power, together with the large boiler and funnel and all the connections and fittings, were fitted on board in twenty-four hours; the making-up lengths of steam pipe, the ladders, gratings, and platforms were fitted and steam got up in the boilers, and the engines satisfactorily steamed in presence of the surveyors at 10 A. M. on Friday, June 26, the vessel steaming back to her berth in two and one-half days from the time she left the stocks. This is an illustration of the advantages of modern machinery and organization in facilitating the output of marine machinery, and it is believed that so large a set of machinery has never previously been put on board in this short space of time.

A New Refrigerant.

Chloride of methyl is useful as a local refrigerator, but requires an expensive apparatus to utilize it. Dr. Redard, of Geneva, has therefore substituted chloride of ethyl in producing local anæsthesia by refrigeration. It is a colorless liquid of an agreeable odor, and is contained in a sealed tube of glass. When the point of the tube is broken off with pincers, the liquid is allowed to escape in a jet directed on the part to be cooled. The jet can be readily stopped by the finger or a little wax. Each tube holds ten grammes of the ethyl, a quantity sufficient for most operations. Dr. Redard has found it useful in cases of sciatica, neuralgia, and toothache. The new refrigerant is likely to be serviceable in the laboratory. If the jet be directed on a tube containing water, the latter will freeze.

Immigration During Seventy Years.

The immigration into the United States from 1820 to 1890 is the subject of a special report which has been prepared by Major Brock, the chief of the Bureau of Statistics of the Treasury Department. No official record was made of the influx of foreign population to this country before 1820, but the immigration from the close of the revolutionary war to that time is estimated at 225,000. The arrivals of immigrants from 1821 to 1890 were 15,641,688. The arrivals from 1821 to 1830 were 143,439; from 1831 to 1840, 599,125; from 1841 to 1850, 1,713,250; from 1851 to 1860, 2,598,214; from 1861 to 1870, 2,466,752; from 1871 to 1880, 2,944,295; and from 1881 to 1890, 5,176,212.

The following figures give the arrivals of each nationality during the entire period from 1820 to 1890: Germany, 4,551,719; Ireland, 3,501,683; England, 6,460,054; British North American possessions, 1,029,083; Norway and Sweden, 943,330; Austria-Hungary, 464,435; Italy, 414,513; France, 370,162; Russia and Poland, 356,353; Scotland, 329,192; China, 292,578; Switzerland, 176,333; Denmark, 146,237; all other countries, 606,006.

The only leading countries from which arrivals have fallen off in the last ten years are France and China, the total immigration from France from 1871 to 1880 having been 73,301, and from 1881 to 1890, 51,440. The immigration from China amounted to 122,436 from 1871 to 1880, and 51,469 during the years 1881 and 1882, after which the Chinese exclusion bill went into effect.

The year of the largest immigration yet reported was that which ended on June 30, 1882, when the arrivals were 788,992. The immigration from Italy to the United States was 15,401 for the fiscal year 1881, and steadily increased until 1890, when it was 52,003, and the present year, ending June 30, 1891, when the total for ten months has reached 51,153, as against 34,310 for the corresponding months of 1890. The immigration from Hungary amounted in 1881 to 6,826, and in 1890 to 22,062. The figures for ten months of the present year are 22,496. The immigration from Russia and Poland also shows a rapid increase, from 10,655 in 1881 to 46,671 in 1890, and 53,350 for ten months of the present year.

The classification of immigrants during the past decade as to occupation shows that only 26,257 males were of the professional classes, 514,552 were skilled laborers, 1,833,325 were of miscellaneous occupations, 73,327 made no statement in regard to occupation, and 759,450 were without occupation.

The American Society of Microscopists.

This society will hold its thirteenth annual meeting in Washington, D. C., August 10, and will continue in session for five days. Its roll of active members comprises about three hundred and fifty names, including the majority of microscopists in the United States. Every person interested in microscopy should belong to this society, whether able to attend its annual meetings or not, as the reports are well worth the small sum paid for annual dues. The qualifications for membership are simply that the applicant must be respectable socially and interested in the use of the microscope.

We have no doubt a rich treat is in store for microscopists who can attend the Washington meeting.

The present officers of the society are as follows:

Frank L. James, editor St. Louis *Medical and Surgical Journal*, President.

W. H. Seaman, No. 1424 Eleventh Street, Washington, D. C., Secretary.

C. C. Mellor, No. 77 Fifth Avenue, Pittsburg, Pa., Treasurer.

The Cable Speed of Electricity.

The experiments now in progress at McGill College, Montreal, under the auspices of the British and Canadian governments, to ascertain the longitude of Montreal by direct observations from Greenwich, have led to the accomplishment of a remarkable telegraphic feat. The English papers report it thus: "The first thing to determine was the length of time it took a telegraphic signal to cross the Atlantic. An automatic contrivance, whereby the land line could work into the cable, was provided, and a duplex circuit was arranged, so that the signal sent from Montreal would go over the land lines to Canso (Nova Scotia), thence over the cable to Waterville, Ireland, and return to Montreal again. Attached to the sending and receiving apparatus was a chronograph, which measured the time. Out of two hundred signals sent, it was found that the average time taken to cross the Atlantic and back again—a distance of 8,000 miles—occupied a trifle over one second, the exact time being one second and five-hundredths. Professor McLeod is carrying on the experiments with Mr. Hosmer, the manager of the Canadian Pacific telegraphs.

A Young Woman Obtains an Engineer's License in Chicago.

Chicago is a great city, enterprising to an astonishing degree, and in more than one respect is unlike any other city on this continent. She gained the world fair site over all her competitors, and she now has a woman engineer, who has successfully passed the ordeal of a rigid examination.

A contemporary says she was not let off easily either because she was a woman; in fact, the writer says her examination was, if anything, a little more severe than usual.

The young woman walked into the Board of Examiners' room in the City Hall, presented her application in a manly way, deposited the official fee (two dollars), and then made her way into the line of the applicants to await her turn.

Among other questions she was asked was as to the size of the blow-off required for a seven horse power engine, and what she would do if the valve stuck fast. When the examination was finished, the examiners wrote at the end of her paper "accepted," and Miss De Barr is now a full-fledged licensed steam engineer.

THE cost of a palace sleeping car is $15,000; or if "vestibuled," $17,000.

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THE NEWARK WATER WORKS.

The water supply of the city of Newark, N. J., has for some time been unsatisfactory It is derived from the Passaic River, below the cities of Paterson and Passaic, so that the water is far from pure. Hitherto her consumption has amounted to an average of 15,000,000 gallons a day, but recently on one day it rose to 24,000,000 gallons.

The East Jersey Water Company is now rapidly constructing a new water plant designed to supply the city of Newark with water from a distant portion of the Passaic water shed. The water works consist of two storage reservoirs, communicating by natural water courses with an intake reservoir. The latter connects with a steel pipe four feet in diameter, which runs as nearly in a straight line as the inequalities of the country will permit to the present Belleville reservoir, and also to a high service reservoir situated on South Orange Avenue, in the city of Newark.

The bird's eye view illustrates the general scope of the work. The right hand reservoir, termed Oak Ridge reservoir, is situated on the main stream of the Pequannock River. It is formed by an earthwork dam with concrete core. The structure is over 40 ft. high and about 800 ft. long. To the left is seen Clinton reservoir, situated on a branch of the Pequannock River, and formed by a dam of the same general height and construction as above, but about 1,200 ft. long. The dams are fitted with gate houses and connect by natural water courses with the lower reservoir, termed the Macopin intake.

The intake is formed by a masonry dam, 25 ft. high, with a main portion about 250 ft. long, from which a spur 32 ft. high and about 150 ft. long runs into the side hill. These dams are all established upon the solid rock, granite underlying the entire region. The earth dams have spill ways at their sides ; the masonry dam permits the waste to go directly over its crest. These three reservoirs and the natural outflow of other portions of the total drainage area of the Pequannock River constitute the water supply. One of the interesting features of this water supply is the fact that the two main reservoirs are about five miles back from the intake, Clinton reservoir being 300 ft. and Oak Ridge reservoir 200 ft. above it. The water, therefore, in passing over this five miles and down several cataracts, becomes thoroughly aerated before it reaches the Macopin intake.

The ground underneath the reservoirs having been thoroughly cleared from soil, stumps and trees, the construction of the dams was proceeded with. The earthwork of the upper two was deposited in six inch layers, thoroughly wet and rolled. The operation of construction of one of the earthwork dams is shown in the cut. The Macopin intake, built of masonry entirely, is 585 ft. above tide water ; its gate house is provided with four main valves. One set can be used in an emergency to empty ; it the other set connects with the conduit.

The conduit consists of a 4 foot pipe about 25 miles long. It is made of riveted steel, with the longitudinal joints double riveted and the circular joints single riveted only. Its thickness varies from one-quarter to five-sixteenths and three-eighths inch, according to the head of water which it has to sustain. It is made at a special shop at Paterson, N. J., by the contractors, McKee & Millson. The extreme range of temperature to which it is possible to be subjected is 45° Fah., while the probable variation is not over half this amount. The pipe is so designed that changes of length caused by variations of temperature can be safely borne by the elasticity of the whole structure. Starting from the intake, the pipe runs along the Pequannock River valley, thence to Pompton Notch, in Pompton Mountains, thence in an almost straight line to what is known as the Great Notch, in the Orange Mountains, thence it turns a little to the right, as shown in the picture, and runs direct to Newark. In its course it runs up and down hill, forming many true and inverted siphons, but never rising above a hydraulic gradient of 2 : 1000. It crosses the Pompton and Passaic Rivers on steel truss bridges with stone piers. It is carried under the Pequannock and Second Rivers. Three times it goes under the Morris Canal.

The general terms of the contract entered into between the East Jersey Water Company and the city of Newark are as follows :

The works are to have a capacity of 50,000,000 gallons daily. Upon completion the city of Newark is to pay $4,000,000. For this it is to have the privilege of drawing 27½ million gallons daily up to the year 1900. Until this period the company can draw all the water not used by the city of Newark. In 1900, Newark is to get possession of the entire water supply and is to pay the company an additional sum of $2,000,000, the East Jersey Water Company operating and maintaining the works until 1900. Before that time the company will have to build other works to supply its customers, meantime supplied from the Newark conduit.

The work is in charge of Clemens Herschel, M. Am. Soc. C. E., also M. Inst. C. E., who is engineer and superintendent for the company.

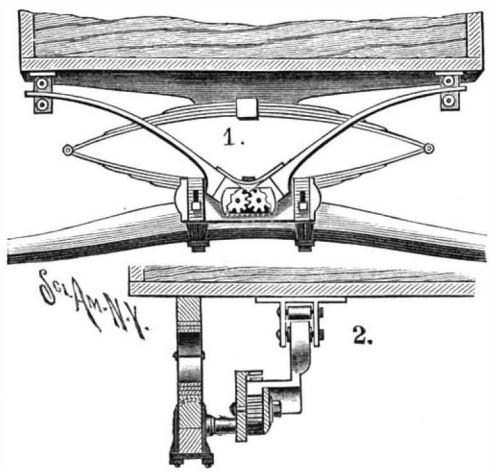
As illustrating some of the modern uses of the long distance telephone, it is interesting to observe how the office in New York, as well as the residence of the superintendent, is in constant telephonic communication with different parts of the works. Telephones being necessary for the operation of the works after completion, they have been established for use during construction at the reservoirs, and a special instrument called the "Perambulator" is kept moving in advance of the pipe laying.

One of the cuts, showing the work upon the conduit at Stone House Brook, near Butler, illustrates the general character of the pipe laying. This part of the operation is done by the contractors, T. A. & R. G. Gillespie, of Pittsburg, Pa. The reservoirs and dams are constructed by the company under Mr. Herschel's direct superintendence. The thoroughness in the work is exemplified in the case of Clinton dam, where 28 feet of drift was cleared away to reach the rock upon which to found the dam. At this depth several large pot holes were found in the ledge, showing that at some remote period the rock had been exposed to the action of some heavy cataract.

The work is progressing with great rapidity, nearly a mile of the conduit is laid every week, and more than one-half is now under ground.

A SPRING EQUALIZER FOR VEHICLES.

The illustration represents an improvement designed to prevent the tilting of a vehicle, by distributing the weight to bear evenly upon the springs, thereby also contributing to their endurance and preventing the twisting of the king bolt. It has been patented by Mr. Marshal T. Foster, of Piedmont, Kansas. Fig. 1 is a broken-away front view showing the application of the equalizer, Fig. 2 being a vertical longitudinal section. The springs are supported on the axle in the usual way, and to the axle clips, which are vertically slotted,



FOSTER'S SPRING EQUALIZER.

a back plate is attached by means of bolts extending through each clip, a sleeve or washer being inserted between the clip and plate to hold the latter and the equalizer arms it supports a sufficient distance back beneath the wagon body.

The slots in the clips allow for the vertical adjustment of the bolts, and the plate is also slotted to allow for further adjustment in adapting the equalizer arms to the vehicle. The plate is also corrugated on one side, and the bolt carries a washer with similar corrugations, so that when the bolt is tightened in place, the plate cannot be moved. The equalizer arms are laterally bent, and are pivoted at their lower widened ends between the plate and a smaller rear plate, the two plates being connected by bolts which serve as pivots for the arms. The inner extremities of the arms are semicircular in shape, and have interlocking cogs, so that when one is moved the other also will be moved, the outer ends of the arms, as shown in Fig. 1, extending between rollers, preferably of rubber, pivoted in brackets attached to the bottom of the wagon body. Mounted on a lug on the center of the plate to which the arms are pivoted is a spring adapted to press against the arms to take up any lost motion. This device may be employed with any kind of vehicle, the depressing of one of the equalizer arms by placing extra weight on one side of the vehicle causing the opposite arm to be also depressed, by means of the interlocking cogs, and thus keeping the vehicle body level and even at all times.

"Staff" for World's Fair Buildings.

Thirty thousand tons, or two thousand carloads, of "staff" will be used in the construction of the main buildings of the Columbian Exposition. It has been decided that all of the buildings will be faced with this material. Staff was invented in France about 1876, and first used in the buildings of the Paris Exposition in 1878. It is composed chiefly of powdered gypsum, the other constituents being alumina, glycerine and dextrine. These are mixed with water without heat, and cast in moulds in any desired shape and allowed to harden.

The natural color is a murky white, but other colors are produced by external washes, rather than by additional ingredients. To prevent brittleness the material is cast around a coarse cloth, bagging or oakum. The casts are shallow, and about half an inch thick. They may be in any form—in imitation of cut stone, rock-faced stone, mouldings, or the most delicate designs. For the lower portions of the walls the material is mixed with cement, which makes it hard. The material is impervious to water.

Alleged Deceptions in German Steel Works.

A correspondent writes as follows to the London *Iron and Steel Trades Journal:* The great lawsuit now proceeding at Essen, Germany, in the matter of income tax defraudations, said to have been practiced for years by the directors and the principal employes of this, the greatest German steel-making establishment, has suddenly taken a most startling turn.

Mr. Wm. Baare, the director-general of the Bochum Union, and one of the greatest industrial princes of Germany, holding the highest official and honorary position, has, in conjunction with others connected with these steel works, been accused of having for many years systematically and purposely defrauded the national, as well as the municipal, revenues by manipulating their income tax estimates in such a way as to avoid paying taxes on almost nine-tenths of their incomes.

The Bochum Steel Works supply most German and a vast number of foreign and colonial railway administrations and companies with steel rails, sleepers, axles, etc., steel requisites for railways and railway carriages, etc., and have always been looked upon as A1 in every respect.

But now the director-general and the board of directors of these great works are accused of having systematically and purposely practiced, at all events connived at the practice of, the most audacious frauds possible for manufacturers and contractors.

The accuser further says that "the Bochum Steel Works, in order to be able to get rid of their inferior steel manufactures, practiced another fraud, namely, substituted for the rails, axles, etc., which had been chosen by the official examiner for being tested for their tensile strength, similar rails, axles, etc., which they had specially made from the very finest 'testing' steel that could be manufactured. The officially stamped rails, axles, etc., were surreptitiously removed, viz., replaced by rails, axles, etc., of much superior material, which had meanwhile been stamped with the fraudulent stamps of the Bochum Works." The tests were made, and invariably proved highly satisfactory.

The accuser produced at once in substantiation of his accusation a quantity of stamps, of which in all some 57 were in use during the last 16 years; moreover, he produced orders to and receipts from the maker of such stamps ; he also gave a number of railway accidents, etc., which he alleges have been caused by breakdowns in consequence of the fraudulent practices of the Bochum Union. The public prosecutor at once stepped in and entered a separate action for wholesale commercial forgeries and defraudations alleged against Mr. Baare, his co-directors, and the Bochum Union.

Pile Driving by Jets.

Mr. Edward Hurst Brown gave a description before the Engineering Club, of Philadelphia, of the application of a water jet to the driving of piles for the boardwalk at Atlantic City, N. J.

The water was brought from the city water supply in a 2 inch pipe, extending along the line of the work. To the end of this pipe (which was extended as the work progressed) was attached a 30 foot length of rubber fire hose terminating in an ordinary brass nozzle about 4 feet long, with an opening of 1¼ inches.

The piles were swung into position by a rough but light tripod, provided with block and fall, and steadied in place by the foreman, while one of the men held the nozzle of the hose vertically and close to the foot of the pile. Under the action of the jet, the pile was lowered into position almost as fast as the men could pay out the rope, the nozzle following it down.

To drive a pile from 6 to 10 feet into the compact beach sand required only from 30 seconds to 1 minute from the time the water was turned on the foot of the pile until the pile was finally fixed in position, the hose withdrawn, and the tripod removed.

The instant the hose was withdrawn, the sand packed at once around the pile, holding it, apparently at least, as firmly as if driven by a ram in the usual way. Should a pile be driven too far, it is easily raised while the jet is on.

The jet process has been successfully used in other parts of New Jersey, in some places through coarse gravel with stones 8 to 10 inches in diameter, but in such cases, of course, the sinking is less rapid than in the beach sand.

When a city water supply is not at hand, a steam force pump is used.

In sinking pipe wells the pipe itself may be used for the jet, but the separate nozzle appears to be preferable.

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Correspondence.

Garnets and Peridots.

To the Editor of the Scientific American:

Being interested in an article by G. F. Kunz, in your issue of July 11, 1891, entitled "Gems of the United States," I will say that I spent three years in the vicinity of the "garnets and peridots" mentioned in that article, and am very familiar with the particular place where they are found abundantly.

I think that the author is misinformed in regard to the finding of them. He says, "they are collected from ant hills and scorpion nests by Indians," etc. Only the very smallest are so gathered, from the size of a pin head to about the size of a rape seed, which are so thick and plentiful that they can be scooped up with the hands as a person would scoop up water using both hands.

The larger ones are gathered after the rains, when they seem to come to the surface.

I have an opal in my possession found at the same place which I consider a stone of much value.

EDWARD F. EASTMAN.

Park City, Summit Co., Utah.

P. S.—I once sent a large bottle (through a Prof. Bibikov) to New York City, for which my share (one-half) of the receipts was $8.

Jet Propulsion.

To the Editor of the Scientific American:

The suggestion of Mr. W. H. Wetherill, in your issue of the 11th inst., that possibly the thrusts from a jet pipe intermittently worked might produce greater propulsion results than the constant jet, is, I think, a step backward instead of forward. It has been the aim of the friends of hydraulic propulsion to produce a powerful, medium, and constant jet; powerful, in that it would strike the water of flotation with such force as to impart to it the resistance of a stone wall; medium (nozzles 12 inches in diameter for a Cunarder 500 feet in length), so that an excessively large quantity of water will not be carried in the vessel, also presenting orifices of a size that will not impair the strength of the hull; constant, on the principle of the screw propeller, which has a continuous thrust; no starting and stopping, which create great waste of power.

There is no danger of boring a hole in the water with a constant jet and a practical size nozzle, as the propelling jet is constantly encountering a new quantity of the resisting element with a greater directness and power than that of the screw. In short, it is no more practical to have intermittent jets than to have intermittent screw propellers. JOHN W. HAHN.

Newton, Mass., July 14, 1891.

Friction of Belts on Pulleys, Etc.

To the Editor of the Scientific American:

Will some one please give us the reason for the difference between the friction of a plane surface and that of a belt on its pulley?

According to the established laws of friction, conditions of surface being equal, it is increase of weight rather than surface contact that increases friction. This applies to plane surface, but not belt friction. We know from practical experience with belt machinery that increased arc of contact without increased tension increases friction.

The reason for this difference between plane surface and belt friction does not appear to be well understood, if known at all. I have been pumping the scientific world some time for the reason, and without success—have been told there has never been any given.

Chetopa, Kansas. J. A. LOUGH.

[The laws of friction apply to belts as well as to plane surfaces, only that we do not interpret them according to the facts as they are, and not as we carelessly see them.

A flat surface contact may be increased without adding to the gross weight on the whole surface, and the friction may not vary. With a belt, every inch that it is wrapped on the circumference of a pulley adds an increment to the frictional weight. The law of the composition of forces fairly demonstrates the belt lap question, and may be illustrated thus: A belt lapping one-quarter around a pulley with one hundred pounds tension each way will have a total pressure on the pulley by the formula for the resolution of forces of 141 pounds. If the belt laps on one-third of the pulley, by the same formula it will have a total pressure of 174 pounds; and if it laps on one-half of the pulley, it will have the total pressure of 200 pounds. In this way, if continued for more than one-half of the circumference of the pulley, the pressure will be proportionally increased.

Therefore we may safely infer from the facts that the law of friction is correct; but its application cannot be applied to elastic bodies drawn over cylindrical surfaces by its broadest terms.—EDITOR.]

FOR a good solution for removing the blue from steel so as to leave as clean as before coloring, try acetic acid, or solution of chloride of tin (stannous chloride).

Gums, Resins, and Balsams.

In the following few notes on several of the better known gums and resins, I have adopted no systematic arrangement. Neither have I said all I should have liked to have said concerning them. But as it was not consistent with the room at my disposal to mention all their various uses, I have suppressed the minor properties and given in as few words as possible the more interesting features.

I have endeavored to give the name of the plant producing each variety, together with its uses, native country and other interesting items.

The distinctions between gums, resins, and balsams may be briefly tabulated as follows:

Resins are the inspissated or thickened juices of plants. They are generally mixed with an essential oil, are insoluble in water, but are soluble enough in either alcohol or the essential oils. Their general characters are inflammability and fusibility. Their ultimate components are carbon, oxygen, and hydrogen.

Gums are soluble in water, but are insoluble in alcohol.

Balsams or *gum resins* contain a quantity of gum, are partly soluble in water, partly so in alcohol, or in other words, they take both alcohol and water to perfectly dissolve them.

Gum arabic is produced by several species of acacia. It is quite soluble in water, but in alcohol, ether, and oils it is insoluble. It forms an acid solution, as permalate of lime is present. Several of the metallic oxides combine with it. It is very nutritious, so much so that the Arabs who gather it nearly live upon it during harvest time. We import it from the Levant, Barbary, Senegal, Cape of Good Hope, India, Cairo, etc.

Gum senegal, the product of *Acacia senegal*. This is the best kind of Arabian gum. It is much more clear than gum arabic, sometimes entirely white, in drops as large as a pigeon's egg. Its principal use is in the manufacture of silks, muslins, crapes, etc., to give them the requisite amount of stiffness and glaze. It is also mixed with the colors in calico printing to give them solidity.

Gum tragacanth or gum dragon. This is obtained from *Astralagus tragacantha*. In appearance it resembles twisted ribbons, of a brownish white color, opaque and rather ductile. When pulverized in a mortar it is of a white color. The operation of pulverizing is a difficult one, and should be performed in a hot mortar, the gum having been previously heated to 212° Fahr. This gum has a remarkable power of consistence, a small piece swelling up to many times its own size. It has not, however, such a strong power of adhesiveness as gum arabic, but if equal parts of the two be mixed together it forms a nice white gum, very suitable for fastening plants to paper, and other natural history work. The tree is itself a native of Crete.

Gum sandarach. The product of *Callitris quadrivalvis* is a native of Barbary. This gum is chiefly used in the manufacture of varnishes, for which it is peculiarly adapted. The Turks employ the wood in the construction of their mosques, it being very tough and possessing great lasting qualities. Importation about fifteen tons per annum.

Barbary gum, a very dark looking kind produced by the *Acacia gummifera*. In the manufacture of lozenges and confectionery it has valuable qualities. It calls for no special comment. We import it from the Morocco coast.

Gum gedda, an inferior quality of the foregoing. Reddish color.

Canada balsam. This is supplied by the *Abies balsamifera*. It is contained in blisters in the bark. The blisters are punctured, and the balsam is collected as it exudes. This is a most useful substance, being in great demand in a number of manufactures, etc. It is used in cementing lenses together. In microscopy comment is needless, but besides being an excellent preservative, it gives great transparency to the object. We import nearly all of it from America.

Guaiacum. This resin exudes from the *Guaiacum officinale*, a native of Jamaica and the surrounding islands. A piece of paper treated with tincture of guaiacum takes on a green tint under the violet rays, when exposed to the prismatic spectrum, through oxidation. Red rays destroy the color. Solubility, 90 per cent in absolute alcohol. Lignum vitæ, the hardest and heaviest wood known, and which sinks on being placed in water, is the timber of this tree.

Copal. This is the product of several leguminous plants in Africa, East Indies, South America, and Australia. It is generally seen in large angular lumps, often as large as a hen's egg, of a bright yellow color, and very transparent. The African variety is of a darker color, and not so transparent, its surface appears dusty. The Australian is the largest. That from the East Indies is the product of *Hymenæa courbaril*. In lumps sometimes nearly square and generally covered all over with slight indentations. It is known as gum anime. Chiefly used for fine varnishes.

Gum mastic, the product of *Pistacia lentiscus*. In small ovoid and round tears about the size of a pea and rather flattened. The tree is a native of Chio and Northern Africa. To obtain the resin the bark is cut transversely, after which the mastic exudes in small drops and either hardens on the bark or falls to the ground; that which falls to the ground is the inferior quality. It has a fragrant smell, and is much used by the Turkish ladies in their toilet. A fine varnish is made from it. Dentists also use it for stopping hollow teeth. About ten or twelve tons are imported annually, mostly from the Levant.

Gum dammar; this is a light colored substance which is obtained from the *Pinus dammara*, native in India, from whence it is exported. It is very useful in making varnishes, especially photographic. It is soluble in benzole, only partly so in alcohol, and is used sometimes as a substitute for Canada balsam.

Gum gamboge, a product of *Hedradendron gambogioides*, native on the Malabar coast and in Ceylon. It is a gum resin, and is obtained by puncturing the bark of the tree when the flowers begin to appear. We know it best by its appearance in amorphous masses, but it also takes the form of hollow rolls and solid cylinders. The best hollow rolls come from Siam. From this gum the beautiful yellow color of gamboge is manufactured.

Gutta percha, the inspissated juice of *Isonandra gutta*. When freshly gathered it is rough, dry, slightly soluble and very inflammable. To render it fit for use it is immersed in boiling water; this softens it and makes it capable of being moulded into any shape, which it retains when cold.

The juice is found between the bark and the wood. Its uses are too numerous to specify, many being too well known.

Caoutchouc, India rubber, is the product of many euphorbiaceous plants. We get most of it from the Brazils and Central America. In Brazil it is obtained from the *Siphonia elastica*, which grows to a height of between fifty to sixty feet, and in Central America it is obtained from *Castilloa elastica*. Most of that we now use comes from Central America, where the juice is simply collected into cups, from incisions made in the bark. To coagulate the milky juice and convert it into rubber fit for exportation, the juice of a vine called "achuca" is mixed with it, and so powerful is its action that five or six minutes is sufficient to produce coagulation. The Brazilian method slightly differs. The juice is first collected in clay bowls, it is then smeared over various shaped moulds, made also in clay and taking the form of bottles, balls, spindles, etc. Successive coats are laid on, each one having previously been allowed to thoroughly dry, either in the sun or in the smoke of a fire, which blackens it. When a sufficient thickness is obtained, the clay is washed out, leaving the India rubber ready for exportation. The trees yield twenty or thirty gallons of juice, and when we consider that each gallon will produce two pounds of market India rubber, the harvest is not so bad. Other trees producing caoutchouc are *Siphonia brasiliensis*, *S. lutea*, and *S. brevifolia*.

Dextrine, British gum, torrified starch. To produce this gum, starch is heated until vapor rises; by this procedure the starch becomes soluble both in cold and hot water, and all its gelatinous character disappears. It can also be made by moistening 1,000 parts of dry starch with very dilute nitric acid. It is formed in small blocks and dried in the open air, afterward being placed in an oven heated to 152°. After this they are pulverized and again dried by heat. In color dextrine is pale yellow, insoluble in alcohol, more flexible and not so brittle when dry as gum. Dextrine and starch have the same chemical composition, $C_6H_{10}O_5$. The gum on the back of postage stamps is dextrine.

Turpentine. This valuable fluid is the product of several trees, principally *Pinus palustris* and *P. tæda*. Most of it comes from the United States, generally in large barrels, of the consistence of treacle or honey. The oil is obtained by distillation and the remainder is the common resin, sometimes called rosin, which is applied to a variety of uses. There are several kinds of turpentine, viz., Venice turpentine, procured from the *Abies larix*, Strasburg, from *Abies pectinata*, Bordeaux turpentine, from the *Pinus pinaster*, and Chio turps, from the *Pistacia terebinthis*.

Gum thus or frankincense, an odoriferous product of the *Boswellia serrata*. It is of slight use except for its odor, which the Roman Catholics turn to account in their churches. Employed also by the ancient priests of Egypt, its odor destroying the foul emanations from the sacrifices. It is imported from India and sometimes the Levant.

Asafœtida (*Narthex asafœtida*). This flows from incisions made in the root of the tree. In color it is milky white, but after it has been dried it takes on a pinkish tint and is curiously mottled. It has a most unpleasant odor. Afghanistan and Persia is the home of the tree. It is used medicinally as an anti-spasmodic in cases of asthma.—*H. Durrant, Hardwicke's Science-Gossip.*

ZINC expands up to the melting point. A bar of hammered zinc 6 in. long will expand one one-hundredth of an inch in raising the temperature 100° Fah.

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THE GREAT DAM AT BEETALOO, AUSTRALIA.

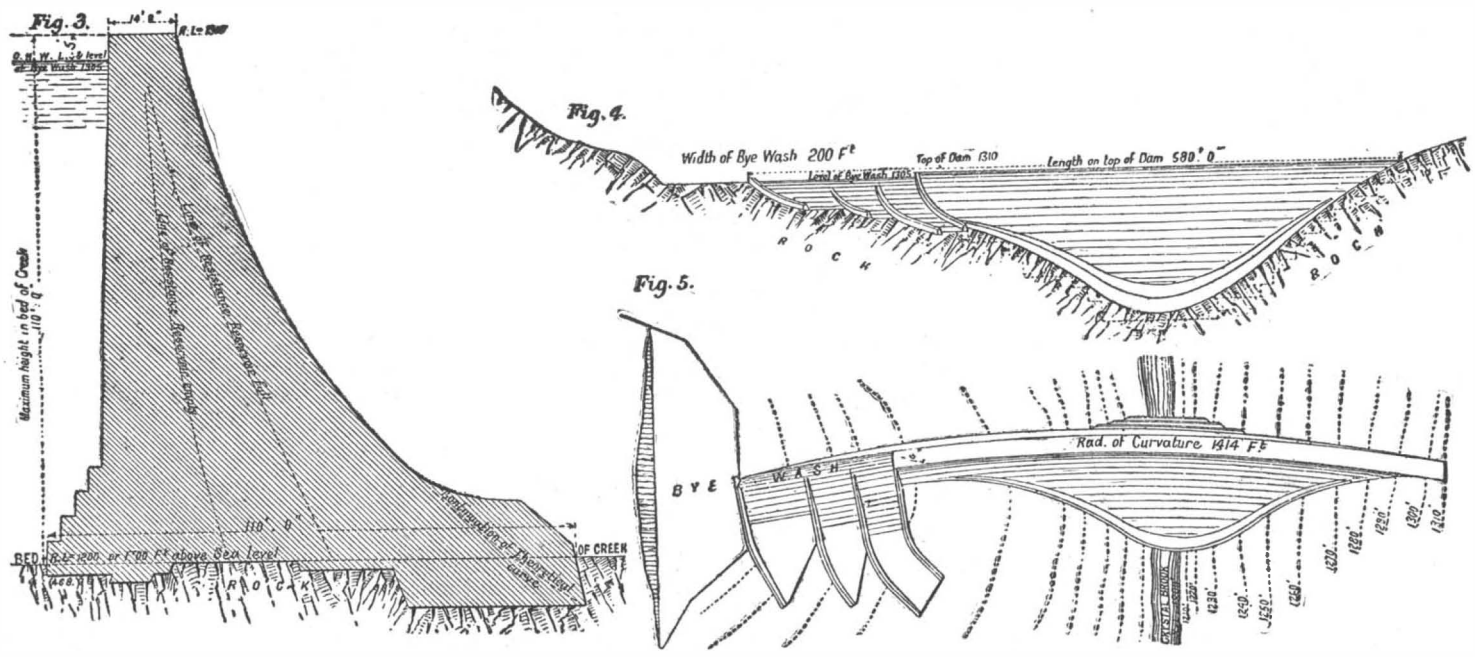
We give illustrations of what we understand is the largest reservoir dam in the southern hemisphere, and which has been recently completed by Mr. A. B. Moncrieff, M.I.C.E., at Beetaloo, South Australia, for the government of the colony. The principal picture gives a general view of the work as complete, while the profile, plan, and arrangement of by-washes are clearly shown in Figs. 3, 4, and 5. The structure is of concrete, 110 ft. high from the bed of the creek to the top of the dam, and 580 ft. long, being curved in plan to a radius of 1,414 ft., as shown in Fig. 5. The width at the top is 14 ft., and the profile of the section has been designed in accordance with Rankine's rules. The width of the section at the foundation is 110 ft. The crest of the by-wash, which is 200 ft. wide, is 5 ft. below the crest of the dam. The reservoir behind the dam, when full, will be 1¼ miles long, with an average width of 8 chains, forming quite a fine lake. The capacity, under these conditions, will be 800,000,000 gallons, a large quantity, but not too much for the district to be supplied, which has an area of 1,715 square miles. Eight separate townships are to be supplied from this source, in addition to pastoralists and farmers. Already 255 miles of pipe have been laid, the largest size being 18 inches in diameter and the smallest 2 inches. All these pipes have been manufactured in the colony, and the engineer has expressed himself well satisfied with the quality.

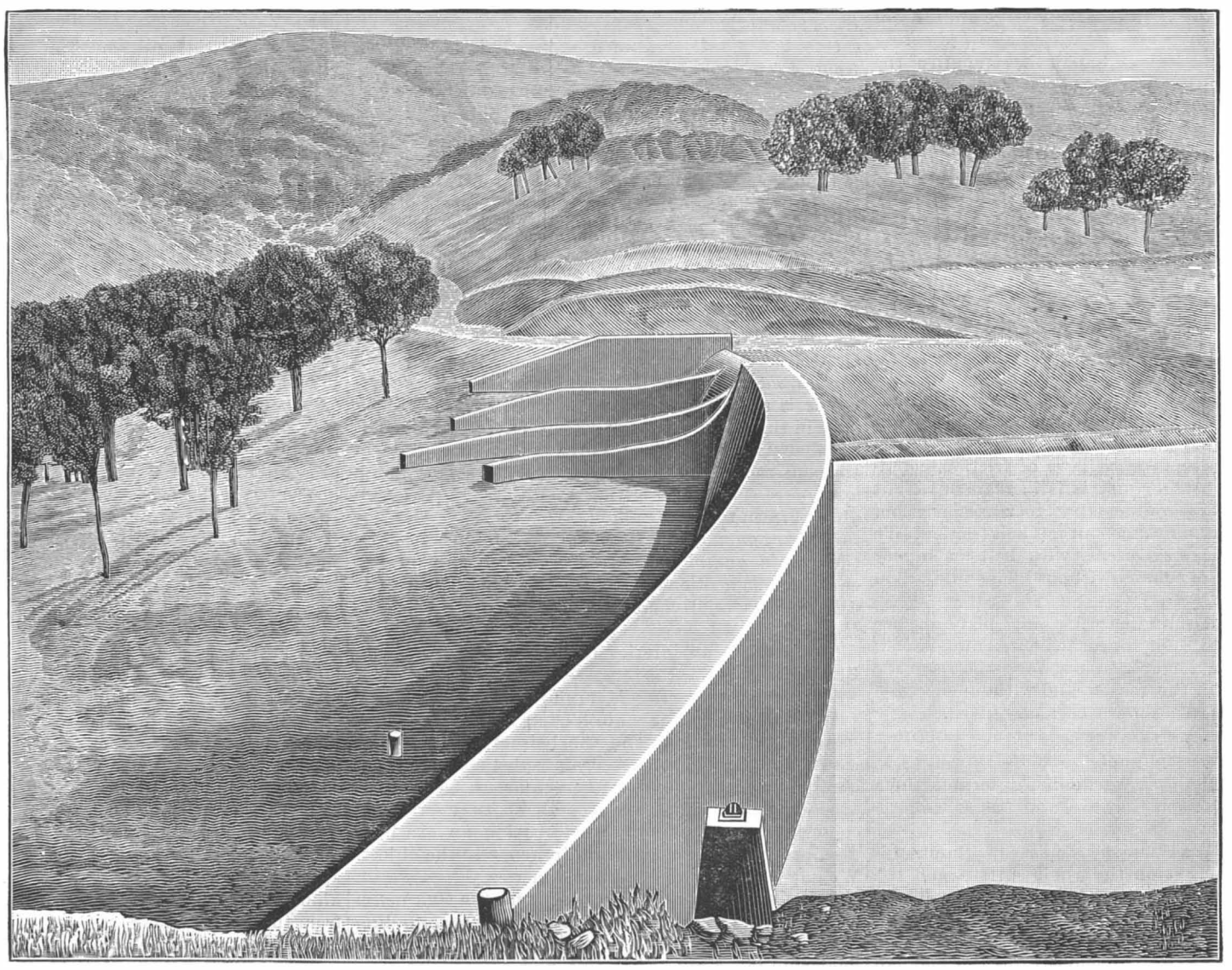
The work of building the dam was commenced in 1888, under the superintendence of Mr. Mestayer, M.I.C.E. In May of the same year, Mr. Moncrieff took the work in hand, and has now brought it successfully to completion, as already stated. The quantity of concrete used was 60,000 cubic yards, the net time occupied being about 2½ years. The stone and sand were obtained in the vicinity, but the cement was imported. Special machinery was used for mixing the concrete and depositing it in place. The net cost of the dam has been $585,000, or rather less than $10 per cubic yard of concrete in place.

The foregoing particulars and illustrations are from a recent number of *Engineering*. It is interesting to compare the described structure with a proposed work for a similar purpose, the construction of which was at one time strongly urged, but is at present held in abeyance. We allude to the proposed Quaker Bridge dam, on the line of the Croton water works of New York City.

The Quaker Bridge dam, as planned, was to have a foundation 69 ft. deep at the deepest part, and above this the dam proper was to rise 192½ ft. Width at the base, 200 ft., at the top 22 ft. wide, with roadway thereon. Length of the dam at coping 1,350 ft. Length at datum level 510 ft. Width at that level 172 ft. Foundation concrete. Main dam rubble masonry, faced with stonework. Estimated to cost $5,000,000. The estimated impoundage of water to be held by this dam was thirty-two billions of gallons, or sufficient for 160 days' supply for the city of New York, using two hundred millions of gallons daily.

BELTS that slip from overwork are benefited by lagging the pulleys.





THE GREAT CONCRETE DAM AT BEETALOO, AUSTRALIA.

Electrical Observations on the Hoher Sonnblick.

From the results of a series of experiments and of observations on the Hoher Sonnblick at a height of 10,168 ft. above the sea level, Profs. Elster and Geitel draw the following conclusions in the *Wiener Berichte*: 1. The intensity of the most refrangible rays of the sun's spectrum, as measured by its discharging action on negatively electrified surfaces of amalgamated zinc, increases with the height above level ground, in such a manner that at a height of 10,168 ft. it is *twice* as great as on ordinary level ground. 2. Notwithstanding this increase, no new actinometrically active substances were discovered. 3. Waterfalls can produce negative falls of potential in a valley, and even to considerable heights, 1,600 ft. 4. Before the outburst of storms observed on the 16th, 18th, and 20th July, 1890, the positive fall of potential, within the cloud which sent only a small quantity of rain, sank slowly down to the value zero, at which it then remained for a long time, perhaps two to three hours, until the electrical process in the cloud definitely came to an end. 5. In storm clouds the atmospheric electricity usually changes its sign after a discharge of lightning, as with storms in the plain. 6. St. Elmo's fire was found to constantly accompany storms; it was not found that *negative* St. Elmo's fire was more infrequent than *positive*. 7. The observation that negative St. Elmo's fire follows bluish lightning, and positive, reddish lightning, was frequently confirmed. The direction, then, of the electrical current which traverses the atmosphere in the form of lightning appears to have an influence on the color of lightning.

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Another Subway under the Thames.

An iron subway or tunnel under the river Thames just below Kingston Bridge has recently been completed for the Southwark and Vauxhall Water Company, under the direction of their engineer, Mr. J. W. Restler. The work has been carried out by Messrs. John Aird & Sons, who are the contractors for laying the main pipes of this company from Hampton to Nunhead, of which the subway forms a part. The necessity for the work has arisen from the circumstance that the population of the large district served by this company has greatly increased. The new scheme in its entirety consists of a cast iron main pipe, 42 inches in diameter, running from Hampton to Nunhead. In the tunnel the main is divided into two pipes of 31 inches diameter; but elsewhere throughout the length it is a 42 inch pipe. The main commences at the company's works at Hampton, and after passing under the river at Kingston it continues along main roads and across fields by Norbiton station over Coombe Hill *via* Raynes Park and Merton Abbey to Tooting, thence *via* Streatham, crossing the Croydon Road and Streatham Common, to Tulse Hill, past Dulwich College, across Dulwich Park, and by Honor Oak to the Nunhead reservoirs of the Southwark and Vauxhall Water Company.

On the route between Kingston and Nunhead, the main passes five times through subways constructed under the London, Brighton & South Coast Railway and its branches. The total length of the main is about 15½ miles. The tunnel is of a circular section, 9 feet in diameter, and is constructed of cast iron plates 1 inch thick, bolted together in segments, and in lengths of 18 inches. The method employed in driving the tunnel and fixing the plates is similar to that adopted in the construction of the City and South London Electric Railway from Stockwell to London Bridge. An iron shield of slightly larger diameter than the tunnel itself is forced forward into the clay by means of powerful hydraulic jacks, for a distance of about 18 inches, sufficient to insert one ring of the cast iron plates. The plates are then fixed and bolted together in position, and the shield impelled forward as before. [This is the Beach hydraulic shield, an American invention, first used in constructing the short section of railway tunnel under Broadway, New York, 1869-1870.—Ed. S. A.] By these means the earth in the tunnel is taken out as nearly as possible to the precise dimensions of the iron ring to be inserted; but in order to make the work perfectly solid and secure, a grouting of liquid cement was forced in behind and around the ring when finally fixed, thus filling up every possible space, fissure, and crevice between the iron and the surrounding clay. The progress made in this way was very rapid, as many as eight 18 inch rings or 12 feet of tunneling being sometimes completed in 24 hours, the whole work of tunneling under the river, a distance of about 190 yards, having been actually completed in 9 weeks. It may be mentioned, as a somewhat remarkable circumstance, that the depth between the top of the tunnel and the bed of the river was in one place not greater than 2 feet 6 inches. The whole length of the tunnel is in the London clay.

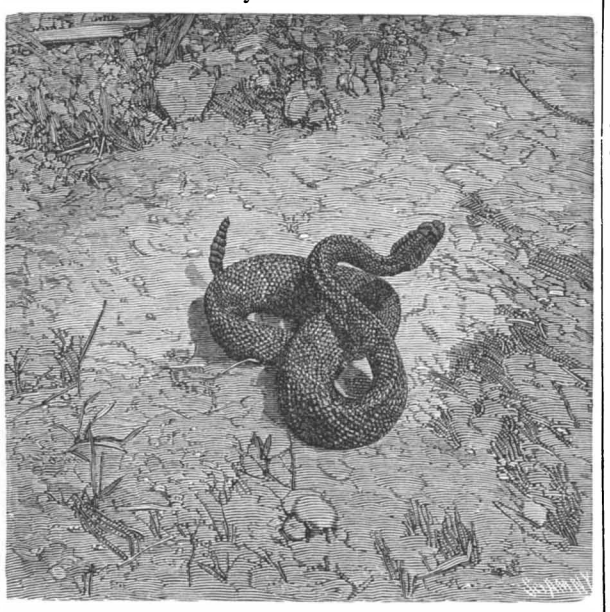
To Remove Tannin from Tea.

The tannin present is absorbed by means of suitable animal substances, such as horn shavings, dried albumen, hide clippings, and the like. It is preferable to add the material to the tea in the dry condition before the infusion is made. But it may also be added to the infusion, or the infusion may be passed or filtered through a layer of the substance. The quantity of animal substance to be added to the tannin-containing material must be determined by the amount of tannin contained in it. In the case of tea the proportion may vary from one to two parts of animal substance to ten parts of tea.—*H. Grimshaw.*

CHARACTERISTIC POISES OF SNAKES.

BY G. R. O'REILLY.

Snakes assume many attitudes when on the defensive, and show their excitement in many different ways. For instance, the rattlesnake does not hiss, but vibrates the extremity of his tail, placing it in a somewhat vertical position, while the cribo, of Trinidad (*Spilotes corais*), and other snakes without rattles vibrate theirs horizontally. Many African species seem fond of hissing, and the American varieties of shaking their tails.



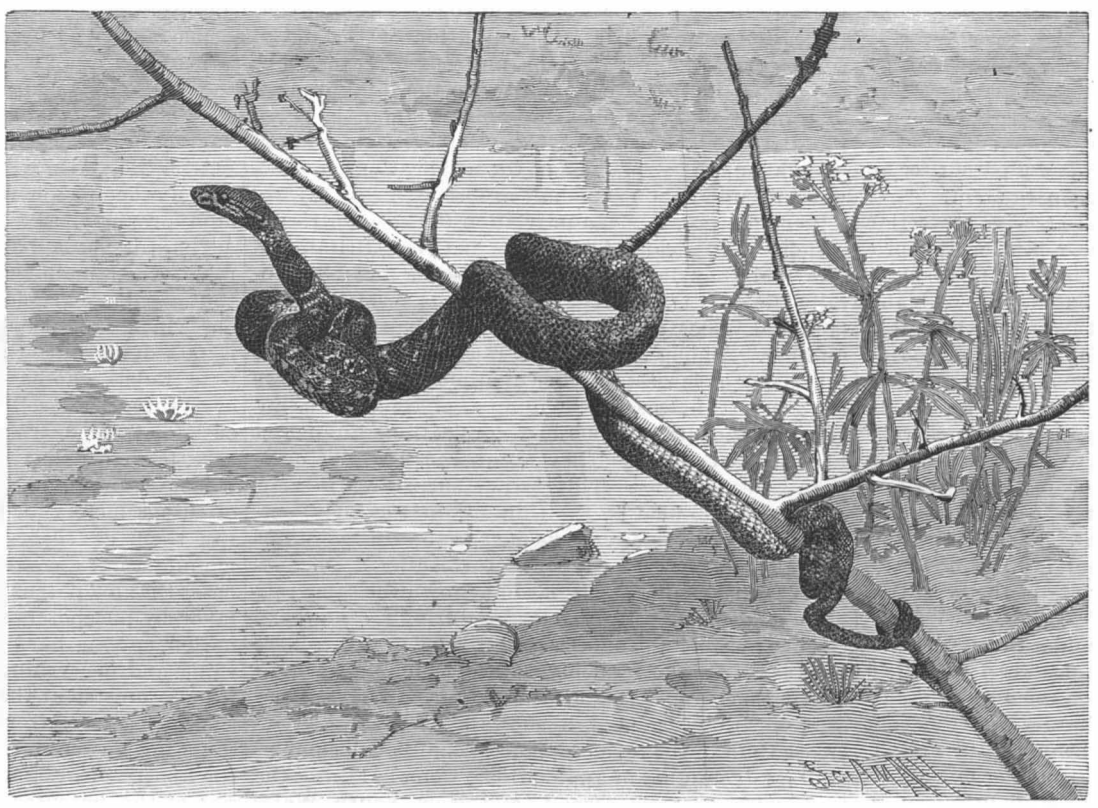
THE RATTLESNAKE IN THE ACT OF RATTLING.

The boa constrictors hold the head well above the ground, while the neck is bent into a series of S-like curves, as may be seen in the engraving of mapanari, *Xiphosoma hortulana*, a tree boa of South America, a bold biter, who considers excitement in a warrior injudicious. Consequently he keeps his tail quietly lapped round a branch, and saves his breath rather than waste it in hissing. The body of the boa is usually flattened at the points of contact with the limb, and this serves to give him greater purchase and a better hold in striking at his prey. The boa's head is always advanced.

The vipers, on the contrary, hold the head rather drawn back, and most of them keep it somewhat down. The terrible fer de lance, of the West Indies, and the labarri, of Demerara, as shown in the cuts given, remain carefully coiled. The traveler who has wandered on South American river banks will never forget the coiled death dealer labarri (*Bothrops atrox*), which, ready alike for enemy or prey, refuses to move from his path. In color he is like the dead leaves of the forest among which he lives. This renders him very difficult to see, and so adds considerably both to the apprehension and to the danger of hunters and others whose business or pleasure leads them to journey on foot through these tangled tropical wilds. When he strikes, his head, with perhaps two-thirds of his body, is shot out like lightning. This snake will strike again and again, unlike the rattlesnake, the bushmaster, and others that are usually satisfied with one injection of poison.

The fer de lance makes his home in the cane fields of Martinique. His coil is exactly like that of the labarri. And so with the bushmaster of Demerara (*Lachesis mutus*). The three last mentioned species all vibrate the tail. The coil of the rattlesnake is not so compact. Another snake that has a peculiar characteristic is the lora (*Ahætulla liocerca*), of Venezuela. He is a whip-like diurnal tree snake, of four or five feet in length and half an inch in diameter at his thickest part. His coloring is of the richest imaginable hues. The head and back are of the most beautiful green. Along each side is a band of golden yellow and beneath he is of a mother of pearl white. His home is among the flowers of the vine-laced forest. There he lies in wait for his favorite prey, the humming bird, or chases the agile tree lizard from branch to branch. In Trinidad he is often seen in the gardens of the town of Port of Spain.

If you approach him too closely, he gets ready for defense in a strange way; for while other snakes as a rule keep their mouths closed, the lora, like a scolding wife or a noisy politician, keeps it open all the time, but all this fuss means nothing; as he is not poisonous and can kill nothing larger than a humming bird or a small lizard. His head is raised, flattened and drawn backward, and his apparently toothless mouth is ever constantly open to its widest extent. He bites fiercely, nevertheless, at whatever approaches him. The liquer (*Dryiophis acuminata*) acts similarly, but does not bite at all.

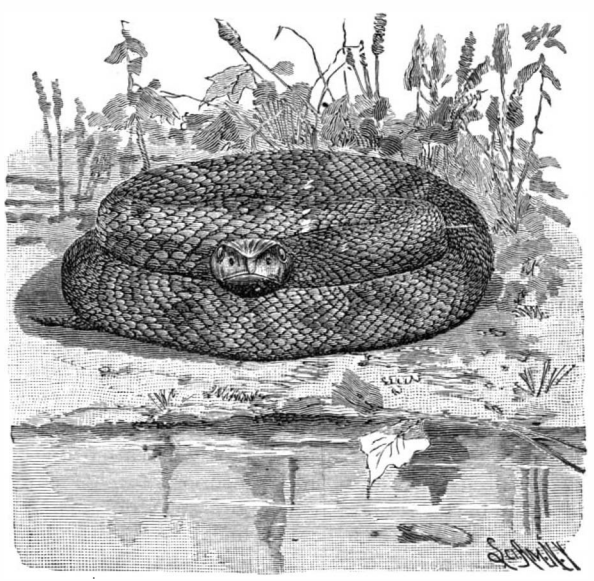


A TREE SNAKE (XIPHOSOMA HORTULANA) COILED FOR STRIKING.

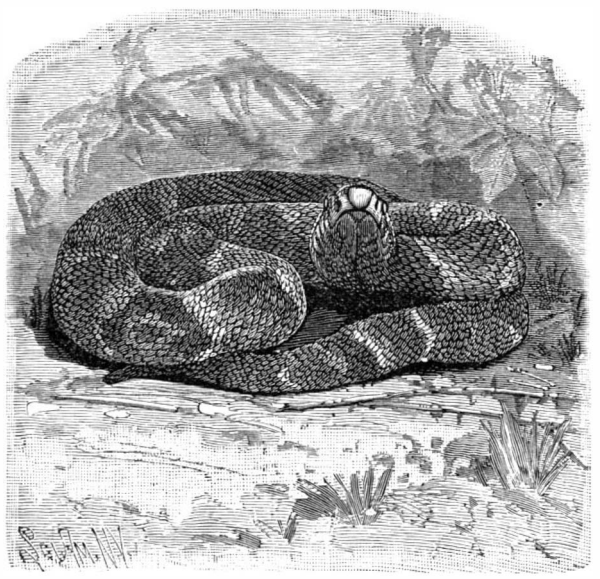
Among the Elapidæ we find two of the most opposite manifestations, for, while the cobras flatten the neck and stand up perpendicularly, facing their assailant, the coral snakes neither flatten themselves out nor stand up, but lie as close to the ground as possible, with the head placed sideways to the object of danger.

Most snakes inflate themselves somewhat when excited, but some, like the small water snake of Trinidad, flatten themselves out as if they had been pressed.

They neither hiss, at least audibly, nor vibrate their tails. This water snake is the only one I know that can actually jump. I have known one ten inches long to jump fifteen inches from the ground.



THE COIL OF THE FER DE LANCE (VENOMOUS).



THE LABARRI (VENOMOUS) READY TO STRIKE.

It has been concluded that whatever preservative is to be applied, the timber for piles, subjected to the action of seaworms, should first be charred, so as to kill any germs near the surface, open the pores of the wood for the antiseptic and destroy the nutritive matter upon which the worms live.

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The New German Patent Law.*

On October 1, the patent law of 1877, under which patents are now granted in Germany, will cease to have effect, and after that date protection will be afforded to inventors by two laws much more liberal than the law now in force.

The first and more important of these laws is the patent law of April 7, 1891. The provision of this law that is most important to American inventors is the second clause of paragraph two, which provides that copies of patents officially published in the United States and other foreign countries shall not act as a bar to the grant of a patent in Germany for the same invention until three months after such publication. Under the law of 1877, now in force, the American inventor must file his application for a German patent on or before the date of issue of his American patent. It frequently happens that an inventor, desirous of protecting his rights in Germany, does not know this and allows his United States patent to issue before he decides to apply for a German patent, and when he does apply he is invariably refused. After October 1, however, inventors will have three months after the issue of their patents here in which to make application in Germany. As not more than three or four weeks are required for the preparation of an application and its transmission to Germany, two months or more remain after the issue of the American patent in which to decide whether it is necessary or expedient to secure protection in Germany.

Three other provisions of the new law are of such importance as to be worthy of special attention. The first of these provides that no patent which has been in force for five years from the date of allowance thereof can be annulled for lack of novelty at the time of application. No other country furnishes such a guarantee of the validity of a patent. The second provision is that publications over 100 years old cannot be cited against applications allowable in other respects. The third provision is that a patent for an improvement on an invention patented in Germany becomes a principal patent if the principal patent is declared void. Under the present law a patent for an improvement expires with the principal patent.

In order to enable the inventors to receive protection on inventions of minor importance, a law for the protection of useful models, supplemental in its workings to the patent law, has been formulated, and will also take effect on October 1. Under this law the benefit of an invention of such nature that it would not pay to protect it by letters patent, on account of the heavy annual taxes, can be enjoyed for six years at a comparatively small cost. This law will undoubtedly be made use of quite extensively by inventors and manufacturers who are satisfied to be protected for a short term of years, as the rights obtained are the same as granted to holders of letters patent. In fact, the law is even more liberal than the patent law, as no examination is made regarding the novelty of the invention embodied in the model.

Although it is to be noted that under the new patent law the time within which an appeal can be taken after the rejection of an application remains the same —namely, four weeks—still it is hardly probable that appeals will be necessary as often as under the present law, as the prime cause of rejection, lack of novelty, is almost entirely removed by the three months clause. The disastrous effects produced under the present law by allowing to a foreign inventor but four weeks in which to receive and reply to a notice from Germany will therefore probably entirely disappear under the working of the law soon to come into force.

The passage of these two laws marks a long step forward, and shows that Germany recognizes the importance of being liberal, not only to her own inventors, but also to those of foreign powers. American inventors will undoubtedly appreciate the importance of the changes that will be effected, as the new laws will do away with most of the drawbacks connected with the present German patent system.

Four Decades of the British Patent System.

As our readers know, the two great English-speaking countries, the United States and Great Britain, lead the world both as regards the number of applications for patents and as regards the number of patents granted. The United States, of course, stands first in the list and Great Britain second. The history of the patent system in the United States has been recently recounted in these columns, on the occasion of the meeting of the congress of inventors and manufacturers, held at Washington, to celebrate the centenary of the American patent system. A report has just been made public in England which gives a less comprehensive but still most interesting account of the history of the British patent system in times comparatively recent. This is the report of the Comptroller-General of Patents, Designs, and Trade Marks for the year 1890, which, in addition to the statistics for that year, gives figures showing the progress of the patent system in Great Britain since the year 1852, or, roughly speaking, for the last four decades. The progress shown by these figures is noteworthy.

Glancing, in the first place, at the figures for 1890, it appears that the number of applications for patents has shown a steady increase, amounting to 21,307, as against 17,110 in 1884. There has been a falling off as compared with the four preceding years in the number of designs and trade marks applied for, though there has been an increase as compared with 1884. The applications for designs, which amounted to 19,515 in 1884, increased to 25,923 in 1888, from which amount they declined to 22,235 in 1890. The applications for trade marks, which amounted to 7,104 in 1884, increased to 13,315 in 1888, from which point they declined to 10,258 in 1890. A more distinct idea of the growth of invention in Great Britain, however, will be gathered from a comparison of the figures of 1852 with those of recent years. In the former year 1,211 applications were received, upon which 914 patents were granted. In 1889, the last year for which complete statistics are at hand, there were 21,008 applications for patents, upon which 10,624 patents were granted. The increase in the number of applications and of patents granted has been most marked since the year 1884, the first year under the patent act of 1883. The growth under the act of 1852 was constant but gradual. The applications for patents grew in number from 1,211 in 1852 to 3,490 in 1862, to 3,970 in 1872, and to 5,993 in 1883, the last year under the old act. The patents granted increased in number from 914 in 1852 to 2,191 in 1862, to 2,771 in 1872, and to 3,962 in 1883. In 1884, under the new act, the applications jumped at once to 17,110, or nearly three times the number for the preceding year, while the patents granted amounted to 9,984, or about two and a half times the number for the year preceding. This remarkable advance is attributed to modifications in the new patent law in the direction of simplification of procedure and diminution of the initial cost of protection. It will be noticed, however, that the proportion of patents granted to the total number of applications is considerably smaller under the act of 1883 than under the act of 1852. Patents were granted upon about three-quarters of the applications in 1852, but only upon about one-half in 1889.

Some figures are given in relation to the countries in which the applicants for patents in Great Britain reside, and they disclose some interesting facts. Naturally the greatest number of applicants reside in England and Wales, which furnish about two-thirds of the number. Among foreign countries the United States furnishes the largest number of applicants, and shows the greatest increase in the number of applications under the act of 1883. American applications numbered 1,181 in 1884; in 1890 they numbered 2,597, or more than twice as many. This is not surprising, in view of the position held by the United States as an inventing country. Germany ranks next to the United States in the list of foreign countries furnishing applicants for British patents, but it has not shown the same rate of increase as the United States during recent years, the increase being from 890 applications in 1884 to 1,336 in 1890. Next in order come France, which shows slight fluctuations, and Austria, where, though the number of applications is small, it shows a more marked increase than in the case of France. The British colonies send a fair number of applications, Canada taking the lead, with Victoria second, and New South Wales third. Comparatively few applications come from the South American countries. Applications, though few in number, have been received from Persia, China, Japan, New Caledonia, from the Sandwich Islands, and even from Fiji, though but one application from the last mentioned place has been received during the last six years. Taken altogether the statistics embodied in the report show that Great Britain is not lagging behind in the march of inventive progress.—*Bradstreet's.*

Volatilization of Iron.

Quite recently Messrs. Mond and Quincke discovered that nickel combines with carbon monoxide to form a nickel-carbon oxide, which promises to be useful in connection with the development of nickel plating. At that time the experimentalists failed to obtain any similar compound of carbon monoxide with another metal. Considering it strange that nickel should be the only metal capable of entering into combination with this particular gas, they persisted in their investigation, more especially with iron, under very varied conditions; and they have at last succeeded in demonstrating the fact that iron is volatilizable, although apparently in very small quantities, in a current of carbonic oxide. This result was communicated to the Chemical Society, and the particulars of Messrs. Mond and Quincke's experiments are reported in the *Journal* of the society. Suffice it to note here that they volatilized some finely divided iron in a current of carbonic oxide at ordinary temperatures; the deposits from this process giving all the known reactions of iron in remarkably brilliant colors. The practical importance of this discovery may or may not be considerable, as further research will be needed to establish the conditions under which the action can take place.

Patent Rights and Wrong.

The London *Journal of Gas Lighting*, in a recent issue, gives a review of the present patent systems, from which we abstract the following:

The British trick of grumbling at everything, and incessantly tinkering away at every established system with a view to keeping it up to popular requirements, is apparently as foreign to the American as it certainly is to the French spirit. The condition of the great American patent system is an example in point. Those who praise it in the extravagant way sometimes heard know nothing about its practical operation. As a matter of fact, it is extravagantly costly to the country, if not to the patentees, and but that any excusable outlet for revenue is desired by the Federal government, the working of the Patent Office would be speedily overhauled. The system of prior examination, of which apologists make so much, is utterly useless, since no guarantee is attached to it, and it only causes vexatious delay in obtaining protection, besides being very expensive. Then the absence of any machinery for removing merely obstructive patents has been already remarked.

The British patent system is anything but perfect, but then nobody pretends that it is. The American system is full of defects, and it is considered treasonable to hint at the existence of a single blot upon it.

We in England have not yet been persuaded by Sir Frederick Bramwell, and by those who think with him in this matter, that patented inventions are absolutely unmixed blessings, and that to invent something patentable is the first duty of man. Indeed, the day of cheap patents in which we now live has brought into prominence certain aspects of patented inventions which are not altogether pleasing to individuals or wholly subservient to the best interests of the community.

The facility with which patents can now be obtained is fostering a novel description of public nuisance—the patentee of "unconsidered trifles," several illustrations of whose vagaries have been recently brought to our notice.

A business firm will patent a variety of construction which other people would regard as a trifle or as common property.

There is yet a hazy impression upon the public mind—the remainder from an earlier state of things—that a patent article must somehow be better than one which cannot be so described. This superstition is fast dying out—thanks, mainly, to the indiscriminate traders who have worked it to death by dubbing everything they sell "patent," merely by way of excuse for their dearness. Until it is quite gone, however, it is clear that a trader has a perfect right to take what advantage of it he can, by patenting all sorts of things merely for the sake of being able to advertise them as such. Thus, for example, if a stove manufacturer discovers, in the ordinary course of business, that a "patent" stove is looked upon with more favor by purchasers simply on account of this designation, he can hardly be blamed for patenting anything and everything of this class which can be made to pass muster at the office. This is a very different thing, however, from a patent for a method of constructing an engineering work, intended to restrict the liberty of designers, and make them ask permission of the patentee to be enabled to do their work in their own way. This is what we have styled a patent outrage.

When a man has invented a new and improved way of doing anything, it is but right and reasonable that he should have at least the credit for the suggestion, and as much profit as the idea can bring him. But for a man to appropriate, by the complaisance of the Patent Office, a notion which is neither better nor worse than many others of the same class or a device which is rather an alternative to ordinary methods than an improvement upon them, and to make this appropriation a means of tying the hands of designers who do not seek to captivate the market, but only to do their work after their own fashion, is a piece of impertinence that requires checking before it grows commoner than it is. It may be asked how the line is to be drawn in this regard between what is a distinct improvement and what is merely an alternative. But the distinction, if not easily defined, is easy to understand. If, for example, a gas engineer wishful to erect a gas holder is informed of a method whereby the work may be done at considerable saving of expense or of time, he may be willing to pay a reasonable proportion of the estimated saving for the privilege of using the new method, and will not object to it as being temporarily private property. Should he, on the other hand, propose, for his convenience, to make a change in the design which is of no particular advantage in itself, he will naturally be wroth when told that some gas holder maker has appropriated the idea, and will either grant him a license to use it, for a consideration, or will graciously waive the claim upon securing the contract for the erection of the holder. This is the sort of thing that inclines people to ask whether, after all, a patent system is not of more harm than good to the public.

*C. S. Champion, in *The Iron Age.*

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The Law of Natural Gas.

The following charge was given to the jury by Judge Gunnison in the case of a consumer at Erie, Pa., who was accused of improper use of natural gas, and found guilty.

"Larceny is the felonious taking and carrying away of the personal property of another. You have heard the ruling of the court upon the question raised by counsel for the defendant, in which it was decided, in accordance with the decisions of several other courts of this State, that gas in the distributing pipes of the gas company is personal property, and the subject of larceny. Gas in the ground before the well is drilled would be real estate or a portion of the real estate. But when the well is drilled and the gas flows from the well into the pipe, what is called in law a 'severance' takes place. The gas is severed from the real estate, and thereupon becomes personal property. In the same manner, to take apples from a tree in an orchard is not larceny, because they are a part of the real estate when attached to the tree; but when the apples are severed from the tree and fall to the ground, to pick them up with the purpose of appropriating them to one's own use might be larceny, because the apples being then severed from the tree become personal property. As long as gas is stored in the earth, it is real estate; it is a part of the earth; but when it becomes severed from the earth by being taken into the distributing pipes of the company and brought (as in this case) 80 miles from where it was stored in the earth, it becomes personal property and is the subject of larceny. So that if the defendant is guilty of feloniously taking and carrying away the gas of the Pennsylvania Gas Company, in the city of Erie, where it has been brought by pipes, he is guilty of larceny.

"The testimony introduced on the part of the commonwealth is to the effect that upon October 1 this defendant appeared at the office of the company, he having been before that a customer of the company and one to whom they had supplied their gas, and notified them to disconnect his stove from the pipes. That thereupon they sent a man to his premises who took away the mixer (which you probably all know is the globe or bulb attached to the pipe just before the point at which the gas enters the stove). That they detached the mixer and disconnected the pipe from the stove to prevent the gas from escaping. That, on February 12, when one of their employes visited the premises of the defendant, they found the pipe connected with the stove again, and a piece of pipe with holes drilled in it, to mix the air with the gas, attached to it, and a fire burning in which the fuel used was gas. He says that he turned the gas off and turned it on again and lighted it, and found that it was gas. Now it is a principle of criminal law that a person found in possession of stolen goods must give a satisfactory account of his possession, or that possession will be taken as evidence of guilt. The defendant has introduced no testimony and called no witness to make a satisfactory explanation of the presence of the gas which was burning in the stove during this time. Of course, there is the evidence of Mr. Walker, who tells you that at the office of the company the defendant told them to disconnect the gas on these premises, but that is the only evidence that shows it was in his possession or that he occupied these premises, because all that the other witnesses know about it is hearsay alone. They got word at the office to go and turn off the gas at Mr. Nicholson's place, but that would be all hearsay. But the testimony of Mr. Walker is to the effect that the defendant himself came to the office and told them to turn off the gas, and that he gave the building and the rooms which he occupied, and that his declaration that he occupied the rooms would be evidence against him. It might be possible that the gas was not burned there with his knowledge and consent. There is no direct evidence that he ever saw the gas burning there, or that he knew of it. The circumstance that the gas was found burning on the premises and connected with the stove would be a circumstance from which you might legitimately infer that it was he who did it or it was with his consent it was done. The indictment charges him with having taken 120,000 ft. of gas. It is not requisite that the commonwealth prove that he used all that amount; if they prove he used any gas at all, it will be sufficient. Frequently an indictment is found against a man for stealing a large amount of property, and when the proof is presented there may be only evidence to show that he stole one or more of the articles alleged to have been taken; but it is not necessary to prove that he stole all the articles named in the indictment. So if you find this gas was being burned in these premises by his knowledge and consent, in the absence of any testimony to contradict it or to explain the situation and the transaction, you will be justified in finding that he is guilty. It would be sufficient proof to justify such a verdict.

"But, as in all other criminal cases, before returning a verdict of guilty you must be satisfied beyond a reasonable doubt that it was burned with his knowledge and consent; because if it was done without his knowledge and consent, he would not be guilty of the crime, although he might be liable civilly for the gas that was taken, but he would not be guilty of any crime, because it is necessary, in order to convict a man of crime, to show that he had a guilty intent, and if it was done in his absence, when he knew nothing about it, he would not be guilty of any crime. But intent is something that may be inferred from the circumstances, and if the circumstances satisfy you beyond a reasonable doubt that he had knowledge of the fact that this gas was being burned there, then you might properly infer that there was a guilty intent. Intention is a subject of proof by means of circumstances, and that one circumstance would be sufficient from which to infer that intent, if you find that it was with his knowledge and consent. You cannot find, however, from mere suspicion; you must find it upon evidence, and if there is a reasonable doubt in your minds arising from the evidence, such a doubt as a man of ordinarily good judgment would act upon in matters of importance to himself, that reasonable doubt should be given to the defendant, and he should be acquitted.

"Counsel for the defendant asks the court to instruct you that in order to convict the defendant of this charge the jury must be satisfied beyond a reasonable doubt that natural gas in pipes, such as is shown by the evidence of the prosecution, is such personal property as comes under the common law definition of personal property, and as such personal property is the subject of larceny at common law.

"That point is affirmed; but you are instructed by the court that in our opinion natural gas, in the situation in which this was, is personal property and property of value. The fact that an amount of small value is proved to have been taken does not change the nature of the transaction at all. Larceny can be committed as well of one cent as of $1,000; the crime is the same. This being a felony, you have nothing to say about the costs."

Chlorine.

BY GEORGE L. BURDITT.

Chlorine, one of the most abundant of the elements, is the most important member of the halogen group. The other members of the group are bromine, iodine, and fluorine. Their characteristic features are their indifference to one another and their affinity for the metals with which they unite to form a class of salts.

Chlorine (Cl_2, 35·5) was discovered by Scheele in 1774, but it was first recognized as an element by Davy in 1810. It never occurs free in nature, but exists in large quantities in combination with sodium, potassium, calcium, magnesium, and other elements. Sodium chloride (Na Cl) is the principal source. It is also made by the following reaction: $4H\,Cl+MnO_2=MnCl_2+Cl_2+2H_2O$. The chlorine thus produced is a green or greenish yellow gas, with a powerful, suffocating odor. If breathed in small quantities it produces irritation of the air passages and coughing. Chlorine is soluble in about one-half of its bulk of cold water, and the solution which is readily formed by shaking the water and the gas together has the odor, color, and taste of the gas. In consequence of this solubility it cannot be conveniently collected over water. The common method is to collect it in dry bottles by downward displacement. Chlorine is not combustible, although it sometimes supports combustion. Many bodies burn readily in it, as is shown in the case of copper leaf, finely divided antimony, and arsenic. Chlorine is valuable as a disinfectant, a bleaching agent, and an oxidizing agent. Its strong attraction for hydrogen causes it to decompose water and set free oxygen which may unite with something else.

Chlorine combines with all non-metallic elements, forming an important class of compounds, called chlorides, all of which—with the exception of argentic chloride, cuprous and mercurous chlorides—are more or less soluble in water. To test a solution for a chloride, add argentic nitrate. If a chloride is present a white precipitate will be formed. This is argentic chloride, which is insoluble. The commonest chloride we meet with is chloride of sodium (Na Cl), or common salt, the properties of which are well known. The blowpipe test for a chloride is as follows: Make a borax bead and add oxide of copper, then add the substance to be tested. If it is a chloride, a beautiful bluish green flame will be given.

The most important combination of chlorine with the non-metallic elements is its combination with hydrogen to form hydrochloric acid (H Cl). Equal volumes of hydrogen and chlorine may be mixed together in a vessel, and no action will take place while the vessel is kept in the dark. But as soon as it is exposed to direct sunlight, a loud explosion takes place. The gases unite, forming a colorless but strongly acid gas—hydrochloric acid gas. It fumes strongly when exposed to the air. A solution of this gas in water makes hydrochloric acid. The gas is very soluble, water dissolving about 450 times its own volume of it. It is usually made from common salt: $2Na\,Cl+H_2\,SO_4=Na\,H\,SO_4+H\,Cl+Na\,Cl=Na_2\,SO_4+2H\,Cl$. The acid is powerful and gives a strong acid reaction. It dissolves many metals, setting free hydrogen, and forms chlorides. The commercial hydrochloric acid, commonly called muriatic acid or spirit of salt, is generally yellow, owing to impurities. The pure acid is colorless. A little concentrated H_2SO_4 added to about three grammes of salt in a test tube will generate enough of the gas to show its solubility and acid reaction.

Chlorine gas is a great bleaching agent. This power depends upon the fact that chlorine has a greater affinity for hydrogen than for oxygen. If a dry piece of calico is suspended in a jar of chlorine gas, nothing will happen, but if the calico is taken out, moistened, and put back, it will be quickly bleached. The chlorine in the jar combines with the hydrogen of the water on the cloth, and decomposes the water. The oxygen freed from its former combination unites with the coloring matter on the calico and removes it, leaving a white cloth. Bleaching powder, $Ca\,OCl_2$, is commonly used. It is frequently, but improperly, called chloride of lime. When acted upon by an acid it gives chlorine. The cloth to be bleached is first immersed in a solution of bleaching powder, and then dipped into dilute sulphuric acid (H_2SO_4). Chlorine is generated, and the cloth is bleached. This method is much better than the use of chlorine gas, because it gives only the amount of chlorine needed, and only at the place where it is needed—in the fibers of the cloth.—*Popular Science News.*

Growth of the Face.

During the past year investigations upon the physical growth of children have been conducted in the Worcester schools. The preliminary tables on the growth of the female face bring out some facts of considerable interest. There seem to be three distinct periods, the first ending about the seventh year, and the third beginning about the fifteenth year. A striking peculiarity is the seemingly abrupt transition from the types of one period to those of the succeeding. The sudden disappearance of the lower widths of face, and the equally sudden appearance of the types of the succeeding period, *e. g.*, the sudden shooting up of the widths to almost adult dimensions at about the age of 8 or 9, offset by the equally sudden disappearance of the distinctively childish characteristics at the age of 11. These peculiarities also appear at the ages of twelve and fourteen respectively in the succeeding period. This would seem to indicate the very slow growth of some children until the ages of about eight and fourteen respectively are reached, and then a very rapid development of each individual to her proper position in the series. This Axel Key found also to be true with respect to the total height of the Swedish children observed by him.

In the second period very many of the forms are already adult, and if not at their fullest development, have very nearly approached it. From the fifth to the tenth year inclusive the growth is somewhat slow, about 6·5 millimeters in all, but for the next four years, the period of adolescence, the growth is 6·2 millimeters. From the fourteenth year on there is very little advance, the maximum seeming to be reached at about 128 millimeters in the twentieth year. On comparing this growth with that of the male face some differences are noticeable. The male face is, with perhaps a single exception, larger for the same period of life, and for the same years it appears to grow more rapidly and continues to grow later in life. Massing the cases after twenty, the advance is seen to be far beyond the breadth attained at nineteen, rising to about 138 millimeters. At about nine years the two types approach very near, and it is not at all unlikely that, as found in the case of height by Bowditch in Boston and Peckham in Milwaukee, the female face may for a short period become the broader. Further investigations will be required to determine this point, the present investigation having been made on not more than twenty-five hundred persons, including both sexes.—*Prof. Gerald M. West, in Science.*

Two Cylinders in One.

A new departure in compounding locomotives, which is almost as radical as the idea of compounding itself was, has been put into practical and successful operation by F. W. Johnstone, superintendent of motive power of the Mexican Central Railway. Coal costs about $11 per ton on the Mexican Central, and Mr. Johnstone undertook to reduce fuel consumption by the introduction of a compound system of his own, in which the high-pressure cylinder is encircled by the low-pressure cylinder.

The high-pressure cylinder is 14 inches in diameter, and the low-pressure cylinder has a diameter of 30¾ inches, which is equal to a cylinder 24¼ inches in diameter. The stroke is 24 inches, and the two rods of the low-pressure piston are coupled with the single high-pressure rod to one crosshead. In a competitive test of 12 trips with a single engine, the compound locomotive showed economy in fuel of about 25 per cent, which means a great deal on a road where the fuel account is the largest item of operating expenses, being 22 per cent of the total.

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RECENTLY PATENTED INVENTIONS.

Railway Appliances.

CAR COUPLING.—Moralis Hall, Greenfield, Tenn. A yieldingly mounted drawbar has a hook at each end, the hooks extending in opposite directions and the bar being reversible, while in one end of the drawbar is mounted a spring-actuated shaft to which is secured a U-shaped link, there being an auxiliary link on the opposite end of the drawbar, and a bar secured to the link being adapted for connection with a similar link on the drawbar at the opposite end of the car. The device is intended to facilitate the ready coupling and uncoupling of cars of different heights, as well as for use with cars having the ordinary link and pin coupling, and to do this the trainmen do not have to go between the cars.

CATTLE CAR. — Ferdinand E. Canda, New York City. This car is constructed with main overlapping ways or runs and auxiliary ways or runs, with flexible partitions movable in the ways, the main ways forming guides for the main portion of the partitions and the auxiliary ways forming guides to receive the lower ends of the partitions, whereby the car is divided into stalls or compartments when used to transport cattle. The gate is to be moved to a position just beneath the ceilings when the car is to be used for general freight purposes. This improvement is only one of a series of inventions in this line for which patents have been issued to this inventor.

Mechanical Appliances.

WIRE STAPLE MACHINE. — John Howenstine, Fort Wayne, Ind. In a suitable frame is a cutting and forming die block and a mating perforated die plate on which the die block slides, with a main lever and a movable anvil, while there is a staple moving pusher bar to set a formed staple, and a wire-feeding device. The machine is designed to rapidly form staples from a coil of wire and insert them into the material that is to receive them, the staples being set successively as they are formed, and caused to embrace a stay rod of wire to fasten it in place. The machine is especially adapted to insert staples in wooden packing boxes which are stayed by the use of strengthening rods of wire.

BED FOR PRINTING PLATES. — William MacKay, New York City. This invention provides an improved bed for conveniently supporting metallic plates during the process of printing, to securely hold the plate and permit of adjusting it to present an absolutely true surface and insure accurate printing. The bed is provided with a clamp consisting of a jaw having a shoulder on its upper face, a rounded projection on its inner face, and slots in its lower end, while a second jaw is secured on the upper end of the first jaw and has its front edge beveled and provided with a recess in its under face engaging the shoulder of the other jaw.

LEATHER DRESSING MACHINE. — Marius and Victor Martin, Paris, France. An upper and lower cylinder are mounted, one in fixed and the other in vertically movable bearings, a main lever having connection with the upper cylinder, while a screw secured to the main lever is mounted in the frame of the machine and another screw above the main lever limits its movement. The upper cylinder has a roughened face, and has projecting helicoidal plates between which are layers of brushes, the skins being fed flesh side up between the cylinders. The machine is designed for the treatment of skins, wet or dry, and to perform the different processes of skiving, bleaching, scraping, smoothing, glazing, etc.

Agricultural.

POTATO DIGGER. — A. C. Prentice, Winston, N. C., and C. M. Fuller, South Byron, N. Y. Combined with the frame and driving mechanism is a transverse shovel and an endless belt having a series of rearward projecting fingers, the shovel discharging upon the fingers of the lower half of the belt. The machine, after actual trial, is claimed to save one horse power, and the wear of the parts is reduced to a minimum, while the construction is simple and inexpensive. The potatoes are all carried to one side and left in a narrow row, where they may be quickly picked up. By means of a reversible change of gear, every row can be dug, instead of each alternate row, and the potatoes and vines all carried away from the standing vines.

CULTIVATOR. — John N. Stanley, Ozark, Ark. This invention relates particularly to cotton cultivators, the object of the invention being to provide a machine with a number of interchangeable parts, to be used at different stages of the growth of the plant, also furnishing improved means of securing the scrapers to the standard. A threaded bolt connects the main and second beams, in combination with inwardly curved self-adjusting fenders, and the scrapers and covers. The colters are used when the cotton is young, and to cut away weeds, etc., and may be used in place of coverers in connection with the scrapers. This cultivator can also be used to cultivate corn.

Miscellaneous.

SURVEYOR'S INSTRUMENT. — Solomon Davis, New York City. This is an improvement in instruments employed for measuring distances and magnitude or height of distant objects of triangulation, which is effected without laying off a base line, and more easily and expeditiously than by the ordinary method. Two instruments are employed and a portable base line of known length, which connects them and forms the base of the triangle the length of one side of which is required. Both instruments are supported on tripods, and one, having the features of the ordinary surveyor's level, is used to determine the angles of the triangle, while the other is a distance instrument, similar in many respects to an ordinary azimuth or compass.

THERMOMETER. — Joseph Kent, 98 Hatton Garden, London, England. The glass thermometer stem, having a bore for the mercurial column, is, by this invention, provided with a second open bore, in the rear of the first bore, for the reception and protection of a scale-marked strip, preferably made of enamel, to be secured in position by sealing it to the glass. The improvement is more especially designed for clinical or chemical thermometers, where the external markings of the scale are liable to be defaced or destroyed by the acids used in cleaning, etc.

ADDING MACHINE. — William F. Lawrenz, Duluth, Minn. This is an improvement for use on cash registers and indicators, and is mounted in a casing formed integrally with the register and indicator, or separately, and attached to the frame of the register. It is adapted to register the exact total amount of money in the till or drawer, or when differently set to register the amount of money registered by the cash register each day, week, or month, giving thus the exact amount of sales for the period for which the machine is set. The machine is simple and durable in construction, and the levers which actuate the cash register and indicator simultaneously through suitable connections actuate the adding machine.

CASH CARRIER.—Samuel J. Besthoff, New York City. This is a self-propelling cash car of simple and durable construction, in which the propelling mechanism is wound up and put in operative position by manipulating the cash receptacle of the car or its cover. The car has a swinging door over its cash compartment and a spring-actuated mechanism combined with a pawl and ratchet winding mechanism, operated by the hinged end of the door. If the mechanism should be overwound by the frequent opening and closing of the cover before the car is placed on the track, means are provided for relieving the superfluous tension and reducing the speed of the car as desired.

DUPLICATING MACHINE. — Robert Morgeneier and Jasmin P. Bergeron, Winona, Minn. This is a machine designed to facilitate the reproduction, in unlimited number and at small cost, of the most elaborate and delicate carvings and sculptures, as well as natural casts or patterns therefrom, the machine being so made that patterns or models of any proper material will not be damaged by it. A tripping mechanism is arranged in connection with a series of guide fingers of a reciprocating standard, drills or bits with means for revolving them being arranged in connection with the fingers, while there are holders for the pattern and for the material in which the reproduction is to be effected, and means for imparting a corresponding movement to the pattern and the material, the movements being practically universal.

PHOTOGRAPHIC NEGATIVE MARKER.—Benjamin A. Blakemore, Staunton, Va. This is a device to enable photographers to number or otherwise distinctively mark their negatives as they take them, thus avoiding uncertainty in afterward identifying the negative, which is frequently confusing when a considerable interval elapses between the time of sitting and the development of a plate. The invention consists of a stencil plate bearing a number, name or other marking to be applied to the sensitized plate and photographed on the plate simultaneously with the exposure for the sitting.

INCUBATOR. — Frank Frey and Abraham M. Wayne, Quincy, Ill. This invention provides a novel construction designed to facilitate the automatic regulation of the temperature of the incubator by means of a balance thermometer and other peculiar features, and whereby a constant and perfect circulation of water in the heating chamber is obtained. The body of the incubator is made impervious to moisture and cold, and the trays are so made that the heat will reach almost the whole surface of the eggs, the position of the latter being changed expeditiously and conveniently, without liability to breakage. The pans for the interior of the hatching chamber are designed to absorb any surplus of moisture, while also serving to direct the heat in currents to the trays.

AIR COOLING APPARATUS. — George W. Smith, Mount Vernon, N. Y. In a storage chamber is an ice box having a central chamber and an outer surrounding wall spaced to form a passage, a pipe connecting the central chamber and the space, while a blower is provided to effect the circulation of air. The invention is designed to provide a cold air producing apparatus which will be economical in the consumption of refrigerating material, and reliable in operation, whereby the interior air of a sealed chamber used for cold storage may be maintained at a low temperature for the preservation of articles of food and drink.

ARTIFICIAL OYSTER BED.—Achille M. Willis, Rediviva, Va. The bed proper preferably consists of an outer metal frame, across which extends a network of wires to support a spawn-supporting mat, which may be of pine brush, shavings, etc., to which the spawn will adhere, or loam or mud may be used instead for the bed if deemed desirable. Connected with the bed and leading upward therefrom to a float is a chain or other suitable connection, left sufficiently slack to allow for the tides and to prevent accident. These beds are designed to be arranged in sets to cover the bottom, seed oysters or other edible mollusks being placed on them before lowering, while the floats are numbered or otherwise designated to enable the owner to keep account of the condition of the several frames. These beds may be used at depths too great for ordinary oyster dredging, a windlass being employed on the boat to lift them.

BICYCLE. — Walter Stillman, Jr., Closter, N. J. This is an improvement in that class of safety bicycles which are driven by shaft and gear instead of a chain and sprocket gear. The driving mechanism is simple and durable, and may be readily applied to any form of bicycle or tricycle. Provision is made for taking wear on the bevel gears, and a guard effectually covers the mechanism. The frame of the machine has not so many sections as is now customary, because the adjustment of the driving mechanism is contained in itself and does not need the co-operation of the frame, which may be made more solid and durable.

SHOVEL. — William Wright and John M. Barrett, Warrior Station, Ala. This shovel is for removing ashes and cinders from stoves and grates, and is designed for use alternately to sift the unburned or partly burned coal from the ashes and for the removal of the latter. It is a simple and inexpensive utensil, having an elongated blade, with parallel side flanges and open ends, a sifter being formed in one end portion, while a pivoted spring-limbed handle is adapted to lock longitudinally of the blade and removably lock above either end.

BREAST COLLAR FASTENER. — James J. Turner, Casey, Ill. This fastener is adapted to work in front of the horse's neck or breast, and unite the two forward ends of a transversely divided breast collar. It is constructed of two independent sections having oblique-faced inner meeting ends and loop pieces on their outer ends, one inner end having hook-shaped recesses and the meeting end of the other section having curved hooks adapted to engage with the recesses in the adjacent section.

UMBRELLA OR PARASOL.—Charles H. Ely, Atlantic Highlands, James W. Danser, Freehold, and Frank B. Rue, Atlantic Highlands, N. J. This invention provides a novel form of construction for umbrellas, etc., using a paragon frame, to form a knockdown umbrella which may be conveniently carried in a valise or satchel. The outer sections of sectionally constructed ribs are fitted to slide on the inner sections, a runner carrying braces being pivoted at their inner and outer ends, while longitudinally adjustable rods are applied to the braces, and cams controlled by the rods are adapted to lock or release the sliding sections of the ribs relative to the stationary or inner sections.

TROUSERS. — Isaac L. Morris, New York City. This garment has slits or openings at the side forming front and rear sections, the front section having a fly and fastening straps and the back section being adjustably made to fit a narrow or wide back, and provided at its edges with straps and adjustable fastenings, whereby the trousers may be fitted to a person having a wide back and a small stomach or to one having a narrow back and a large stomach.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co., for 25 cents each. Please send name of the patentee, title of invention, and date of this paper.

SCIENTIFIC AMERICAN BUILDING EDITION.

AUGUST NUMBER.—(No. 70.)

TABLE OF CONTENTS.

1. Handsome plate in colors of a row of wooden houses designed by Munn & Co., architects, and erected for Mr. J. H. Shafer at Newark, N. J. Perspective and floor plans. Cost of four houses from $16,000 to $18,000.
2. Colored plate of the beautiful and substantial stone residence of S. Clark, Esq., on Riverside Park, New York. Mr. Henry Kilburn, architect. Two perspective elevations and floor plans.
3. A cottage recently erected at Upsal Station, Pa., at cost of $6,500 complete. Floor plans and perspective elevation.
4. A picturesque cottage erected at Newark, N. J., at a cost of $4,963.72 complete. Perspective and floor plans.
5. A round end house after the style of old English homes, erected at Wayne, Pa. Cost $5,463 complete. Plans and perspective view.
6. Designs for circular stables.
7. View of an iron earthquake church at San Sebastian, Philippine Islands.
8. An attractive residence erected at Brookline, Mass. Cost $10,518 complete. Plans and perspective elevation.
9. Design for the thirteen story Pabst Building at Milwaukee, Wis. The probable cost of the building is $500,000.
10. The collapse of the Y. M. C. A. building at Montreal.
11. Illustration of an easily made piazza.
12. The St. Jerome Chapel, Hotel Des Invalides, Paris.
13. A $1,500 cottage erected at New Dorp, Staten Island. Perspective view and floor plans.
14. St. John's M. E. Church, recently erected at New Rochelle, N. Y., at a total cost of $63,580. Plans and perspective.
15. A cottage erected at Roseville, N. J. Cost $2,800 complete. Floor plans and perspective view.
16. A very convenient and attractive cottage recently erected at New Dorp, Staten Island. Cost $4,950 complete. Perspective and floor plans.
17. A very attractive block of five new dwellings on Seventy-seventh Street, New York City. Plans and perspective elevation.
18. Miscellaneous contents: A millionaire's residence. —An improved hot air furnace, illustrated.—Iron and steel roofing.—Improved woodworking machinery, illustrated.—Architect of the Woman's Building at the Columbian Exhibition, Chicago. —The plain design is the best.—Inside sliding blinds.—An improved tenoning machine, illustrated. — The Cudell trap. — Lightning rods.— Properly anchoring beams in walls.—A proposed universal building law. — Windmills to supply water for houses, etc.—Graphite grease.

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Notes & Queries

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Names and Address must accompany all letters, or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
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Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(3211) E. B. asks: 1. What is the E. M. F. of one cell of Leclanche battery (porous cup Leclanche)? A. 1·47 volts. 2. How many amperes or what fractional part of an ampere will one cell produce? A. About ½ ampere. 3. What is the internal resistance of one cell? A. 5 ohms.

(3212) W. J. A. B. asks: 1. When, where, and by whom was the first dynamo made? A. In 1866, William Varley filed in the British Patent Office a provisional specification for a dynamo electric machine, but this was not published until July, 1867. In February, 1867, Dr. C. W. Siemens read a paper before the Royal Society on the dynamo. Sir Charles Wheatstone read another paper on the same subject at the same meeting, so that it is difficult to state who was the first inventor of the dynamo. 2. When, where, and by whom was the first arc (electric) light made? A. Sir Humphry Davy showed the arc light for the first time in 1810, at the Royal Institution. 3. When, where, and by whom was the first incandescent light made? A. The first incandescent lamp was patented by King, in England, in 1845. 4. Which is cheaper, and how much, horse power, cable, storage battery, or trolley power, for street cars? A. As the conditions vary so much in different places, it will be impossible to give a very satisfactory answer to this query. It is probable, however, that under favorable conditions the cable system is less expensive than either of the others. 5. What is the greatest speed ever attained by an American locomotive with a train? And an English ditto? A. On American railways, 36 miles in 30 minutes, 107 miles in 97 minutes, are two of the best examples of fast running. The average rate of high speed has reached 69 miles an hour; 75 miles and over have been made under the best conditions. It is stated on good authority that there is very little difference in the speed of the fastest trains here and in Europe. 6. What is the greatest diameter of a driving wheel of a locomotive ever built? A. On one of the early engines used on the Camden & Amboy Railroad the driving wheels were 8 feet in diameter. In Europe, large wheels are still in use to some extent, but here large wheels have been abandoned, and 6 feet is the largest. 7. How can

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a dynamo be changed into a motor? A. As a rule, any good dynamo for generating a direct current can be used without change as a motor. 8. How long will 100 gravity (telegraph) cells run a 16 candle power incandescent light (50 volts)? A. It is impracticable to run a 16 candle power 50 volt lamp with 100 gravity cells. 9. How long will 200 cells do it? A. It is impracticable to run incandescent lamps with any number of gravity cells. 10. How many gravity cells would be necessary to charge a storage cell of dimensions 12× 12×12, and how long to do it? A. For charging a storage battery cell, four cells of gravity battery are required. It takes from 7 to 8 hours to charge a storage battery.

(3213) C. E. N. and H. W. McC. ask a recipe for fastening paper to the face of an iron pulley and how to make a good belt glue. A. Scratch the face of the pulley with a rough file thoroughly, so that there are no bright or smooth places. Then swab the surface with a solution of nitric acid 1 part, water 4 parts, for 15 minutes, then wash with boiling hot water. Have prepared a pot of the best tough glue that you can get; stir into the glue a half ounce of a strong solution tannic acid, oak bark, or gall nuts, as convenient to obtain, to a quart of thick glue; stir quickly while hot and apply to the paper or pulley as convenient, and draw the paper as tightly as possible to the pulley, overlapping as many folds as may be required. By a little management and moistening of the paper it will bind very hard on the pulley when dry, and will not come off or get loose until it is worn out. Use strong hardware wrapping paper.

(3214) W. R. asks: 1. How many sulphate of copper batteries would be needed to charge a storage battery for running an 8 candle power electric lamp? A. You will require 4 cells of gravity battery to each cell of storage battery. 2. Should the storage cells be arranged in multiple arc during charging process? A. It is probably best to make the storage and gravity cells up separately, as above suggested. 3. How long will they run above lamp before running out, if used 6 hours daily? A. Storage batteries will not run large lamps for much more than six hours daily. 4. In what time can they be charged after the first thorough charge? A. It requires from seven to eight hours to charge a storage battery. 5. What is the best arrangement for the sulphate of copper cells? Is the Edison-Lalande battery a suitable cell for running an electric lamp? How many of these cells would it take to run an 8 candle power Edison lamp? Where can I find a full and extensive treatise on this last type of electric battery? A. Write the Edison Manufacturing Company, Orange, N. J., with reference to the Edison-Lalande battery.

(3215) E. L. asks if there is a school, preferably in the eastern part of the country, where a young man can take a short special course in electrical engineering without being required to pass the examination in the languages and higher mathematics which the regular colleges require? A. A special course in electrical engineering such as you specify would be best obtained in an electric manufactory or works of some kind. A college could not give a good course to the exclusion of mathematics. You might address Columbia College, of this city, Cornell University, Ithaca, N. Y., and the Stevens Institute of Technology, Hoboken, N. J., for information as to any special or elective courses they may have in electricity.

(3216) C. W. writes: 1. Have you a paper or book on watch finishing? A. We can supply you with the following books on the subject you mention. The "Watch Maker's Hand Book," by Saunier, price $3.50. "A Treatise on Watch Work," by Nelthropp, $2 50. "The Watch and How to Repair It," $1. See page 53 of catalogue, which we send by mail. 2. Would it hurt a person to take brucine internally? A. It is a deadly poison, one of the worst known to man. 3. Is there any difference between brucine and brucin? A. No; it is only a question of spelling.

(3217) E. B. asks for a cement or composition. Kindly favor with a cement and how to apply it to join a close-grained, hard, white marble slab, 8 inches deep by 2 inches thick, 4 feet long, rough-broken into two pieces about the middle of its length, forming a side piece for cradle of a grave, and being always exposed to the inclemency of the weather. A. You might try a cement formed of oxide of zinc mixed with a strong solution of chloride of zinc. It will have to be applied quickly to each half of the stone, and the pieces joined before the cement sets. It will probably be well to experiment on a small piece of stone before applying the cement to the marble.

(3218) J. S. M. asks, What size of wire is suitable for winding field and armature of dynamo described in SUPPLEMENT, No. 161, made size of cuts? A. It depends entirely upon what you intend to do with the machine. For general purposes, however, we think No. 20 on the armature and No. 18 on the field magnet would do for a series machine. 2. What can be put in whitewash for outdoor to increase its adhesive qualities? A. Try skimmed milk. 3. Has there been a genuine history of Stanley's travels in Africa published, and by whom? A. Scribner & Co. of this city publish Stanley's books.

(3219) N. J. asks: 1. Could you give me the recipe for a glue that will withstand water as well as oil and alcohol? A. Marine glue is made by softening pure India rubber (unvulcanized) in benzole or naphtha. To one part of rubber originally used add ten to twenty parts of pulverized shellac, mixing it with the benzole. Rub the mixture well in a mortar, transfer to a cup, and warm upon a water bath (or use a glue pot for this); apply by melting with a warm iron or wire on the surfaces to be united. Do not use a flame. Common glue may be melted with water and one-tenth its weight of bichromate of potash. Exposure to light makes it insoluble. 2. Could you tell me whether such a glue is in the market? A. Marine glue is sold by dealers in microscopic supplies.

(3220) F. C. writes: There is a preparation that when put on the glass of a cheap microscope shows animalcules, bacteria, etc. I think it is some highly fermentive substance like yeast, but have experimented without any success. If you can give me any information about it I will be exceedingly grateful. A. Try old flour paste allowed to stand for several days. Infusorians are quickly developed in an infusion of hay and water.

(3221) T. W. J. asks (1) for directions for softening stone, so that it can be moulded into any desired shape, and again become hard as before. A. Stone cannot be softened as you describe. 2. What liquids (or chemicals) will produce the most intense heat? A. Sulphuric acid and water produce heat far above the boiling point. The acid should be added slowly to the water. There is always danger in doing it.

(3222) J. H. R. asks: How can I detect adulteration in bone meal, or whether it is pure or adulterated? A. The only reliable way is by analysis. It should dissolve without effervescence in nitric acid, but this is a very imperfect test.

(3223) T. L. P. writes: In my daughter's house, being built from plans furnished by your architectural bureau, the floors, which are of white oak, have become disfigured by black stains, probably where damp iron in some way has been in contact with them. I suppose it is tannate of iron. Can you suggest some means of removing this discoloration? A. Try hydrochloric acid diluted with ten volumes of water. If this is not strong enough, try weak solution of oxalic acid. The idea is to use any remedy as weak as possible.

(3224) O. C. K. asks: What advantages and disadvantages are connected with the use of balanced valves on steam engines as compared with the ordinary slide valve actuated by an eccentric attached to crank shaft? A. The advantages are comparative freedom from wear and ease of movement. There being but little friction on the steam chest face, the perfect fit of both faces is maintained, saving leakage, which is a source of economy in running and repair. The gain in power is very small. The disadvantages are only found in their complicated construction and liability to become deranged by inattention to adjustment, the balancing requiring steam tight yet free moving joints. Both kinds being moved by eccentric and rod, there is no difference outside of the steam chest.

(3225) M. E.—New York, Brooklyn, and Berlin are we believe the only cities that have general systems of elevated street railways. In other cities there are spurs of elevated tracks, or viaducts, on which trains pass to depots, etc.

(3226) D. W. S. asks: 1. Will you please tell me how the lights should be connected in circuit of eight light dynamo (SUPPLEMENT, No. 600) so I can use one or more at a time? A. The lamps should be connected up in multiple arc; the field magnet of the dynamo should have about four more layers of wire, and the machine should be connected up as a shunt dynamo. 2. If I should build a machine after the same pattern for 16 lights, and connect lights in multiple, could I burn one singly, the machine running normally? A. Yes; if connected as a shunt machine, with the field magnet winding properly proportioned. 3. Also, can I sell this machine when finished, without infringement of any patent rights? A. This machine when built with a wire armature core does not infringe any patent.

(3227) A. F. F. asks: 1. What sized wires are used in the induction coil of the Blake transmitter? What is the length and width of the core, and of what is it made? Are both coils copper? Is the primary coil insulated? Is there anything placed between the two coils? A. Use No. 36 wire for the secondary and No. 20 for the primary. Use two layers in the primary and 10 or 12 in the secondary. Make the core of the coil of a bundle of fine annealed wire ¾ of an inch in diameter and 3 inches long. The primary and secondary wires are insulated, and the two coils are separated by three or four thicknesses of writing paper wound around the primary. 2. What is an auxiliary magneto bell? Will it work on a line 1½ miles long without using the regular magneto? A. An auxiliary magneto bell is an additional bell put into a telephone circuit. It requires a magneto to operate it.

(3228) F. W. S. writes: A recent fire destroyed our entire stock; our safe preserved our books very nicely. Being enabled to unlock it readily by the combination, we now wish to know from a source of good authority if this safe would still preserve our books through a like fire, and if not, why? A. The preservative qualities of a safe depend chiefly upon the amount of water contained in the filling. Hence for this purpose plaster of Paris, alum, and other salts that hold a high percentage of water are used. If a safe is exposed to a high heat for a considerable time, a portion of the water will be driven out of the filling, and consequently the safe will be impaired.

NEW BOOKS AND PUBLICATIONS.

MASSAGE, THEORETICAL AND PRACTICAL. By Douglas Graham, M.D. Pp. 342. New York: J. H. Vail & Co. 1890.

This is the second edition of a book first published in 1884. It has been revised and enlarged, and the present volume is designed to cover a full description of the best mode of applying massage and its physiological effects as a remedial agent for a far greater number of ailments than it has commonly been supposed to be available for. The effects of massage upon the internal organs, upon complaints peculiar to women, and upon affections of the nervous system, are treated with especial particularity, while rheumatism and joint affections and many other complaints are shown to be beneficially subjected to this treatment, the general comfort and satisfaction derived therefrom making this method of cure, wherever it can be employed, a really enjoyable one.

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INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

July 28, 1891.

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Adjustable bracket, G. H. Christensen ... 456,614
Air for producing motive energy, utilizing compressed, V. Popp ... 456,595
Air for the production of mechanical power, means for utilizing compressed, V. Popp ... 456,594
Alarm lock, J. Swihart ... 456,783
Alloy, anti-friction, C. B. Miller ... 456,898
Animals, horn tip for, T. Cummins ... 456,887
Annunciator, W. C. Dillman ... 456,803
Annunciator, pneumatic, W. H. Hunt ... 456,824
Armatures for motors and generators, N. C. Bassett ... 456,925
Ax handle fastening, J. M. Didero ... 456,802
Axle, vehicle, A. Johnson ... 456,766
Axles, dust cap for vehicle, J. P. Cutler ... 456,556
Axles, mill for rolling fan-tail, L. D. Hill ... 456,570
Bale tie, wire, J. D. Coon ... 456,647
Baling press, W. R. Moseley ... 456,834
Baling presses, device for operating, D. Lostutter ... 456,703
Ball, F. F. Atkinson ... 456,920
Ballot box, E. C. Reiche ... 456,847
Bar. See Hollow bar.
Bar straightening machine, round, L. H. Brightman ... 456,883
Bars into helices, machine for forming, J. Laidlaw ... 456,829
Barrels upstairs, device for carrying, S. G. Francis ... 456,559
Battery. See Secondary battery.
Bearing, ball, A. L. Teetor ... 456,664
Bed, folding, F. E. Stevens ... 456,915
Bending machine, J. H. Peters ... 456,774
Bicycle, A. N. Thompson ... 456,604
Bicycle wheel, C. A. Hartmann ... 456,815
Billiard table register, P. A. Eichler ... 456,693
Bin. See Flour bin.
Bisulphites, apparatus for making, N. H. Brokaw ... 456,791
Blowing engine, S. P. Watt ... 456,643
Boats, paddle attachment for, Rehm & Marx ... 456,846
Boiler. See Steam boiler.
Boiler cleaner, T. E. Jones ... 456,894
Boiler making apparatus, J. Tetlow ... 456,918
Boilers, sediment trap for, Abrams & McGahan ... 456,711
Boilers, steam loop connection for steam, W. C. Kerr ... 456,672
Bolt. See Expansion bolt. Flour bolt.
Book, C. R. Brodix ... 456,717
Book, receipt, C. O. Tangeman ... 456,862
Boot or shoe heel, F. P. McIntyre ... 456,677
Bottle filling machine, G. Rehfuss *et al* ... 456,907
Bouquet holder, R. A. Tyrrel ... 456,745
Box. See Ballot box. File box. Ribbon box. Tooth powder box.
Brace. See Extensible brace.
Bracket. See Adjustable bracket.
Brake. See Car brake. Vehicle brake.
Brush, blacking, W. J. Scott ... 456,911
Brush machine, M. Young ... 456,610
Burner. See Hydrocarbon burner. Lamp burner.
Buttons to materials, securing shank, W. E. Bennett ... 456,926
Cake press, F. M. Leavitt ... 456,656
Camera. See Photographic camera.
Can. See Oil can. Paint can.
Cannon, A. R. Davis ... 456,808
Car body, J. Turner ... 456,864
Car brake, F. Meyer ... 456,674
Car brake, M. A. Yeakley ... 456,750
Car brake mechanism, A. J. Wright ... 456,608, 456,609
Car coupling, E. P. Caldwell ... 456,552
Car coupling, J. T. Friend ... 456,809
Car coupling, L. Groff ... 456,562
Car coupling, C. E. Seabury ... 456,858
Car mileage register, C. C. Gale *et al* ... 456,650
Car replacer, D. E. Sherman ... 456,780
Car seat or cushion, H. S. Hale ... 456,764
Car spring, E. Peckham ... 456,582
Car starter, P. Flood ... 456,762
Car, stock, J. F. Elder ... 456,697
Car ventilating window, F. D. Glover ... 456,561
Car wheel, W. J. Parmelee ... 456,635
Cars, baggage slide for railway, G. D. Sherwin ... 456,601
Cars, mechanism for automatically operating end gates of, J. Parker ... 456,904
Cardboard boxes, apparatus for the manufacture of, A. F. Bird ... 456,878
Card table, F. B. Fay ... 456,698
Cart, road, J. R. Mercereau ... 456,581
Case. See Tobacco case. Upright case.
Cash register and indicator, D. W. Schiek ... 456,912
Cattle dehorning implement, H. N. Joslyn ... 456,575
Ceiling plate, W. H. Stochham ... 456,682
Centrifugal machine, C. J. Jeppesen ... 456,654
Chocolate, preparing sterilized, G. H. Neuhauss *et al* ... 456,589
Chucks, extension jaw for, W. J. C. Rowe ... 456,854
Churn, J. S. Oster ... 456,839
Churn power, hand and foot, A. F. & A. G. Bonham ... 456,790
Cigar bunching machine, C. Browning ... 456,691
Cigar bunching machine, J. Connell ... 456,798
Cigarette machine, J. V. Bohannan ... 456,644
Clamp. See Jeweler's work clamp. Knitting machine clamp. Pipe clamp.
Clamp, B. J. O'Quinn ... 456,634
Clasp for curtains and the like, E. L. Perry ... 456,636
Cleaner. See Boiler cleaner.
Clevis, A. D. Bruton ... 456,793
Clip, C. E. Soule ... 456,743
Closet. See Sanitary closet.
Cloth folding machine, W. A. Richardson ... 456,851
Clutch, W. H. Johnson ... 456,827
Clutch and speed governor, friction, S. G. Henkel ... 456,652
Clutch, friction, W. B. Hosford ... 456,571
Clutch, friction, A. C. Rice ... 456,909
Coiled spring, P. C. Morse ... 456,833
Coin counter, W. P. Huffman ... 456,701
Concentrator and amalgamtor, J. Rodermond ... 456,852
Condenser, R. P. Barnstead ... 456,923
Condenser regulator, electric, J. McBride ... 456,835
Condenser, water jet, E. Korting ... 456,828
Coupling. See Car coupling. Hose coupling.
Crate, folding, S. W. Hurlburt ... 456,653
Cuffs and collar blanks, machine for infolding the edges of, J. K. P. Pine ... 456,906
Cultivator, sulky, J. L. Butler ... 456,551
Current motor, alternating, M. Von Dolivo-Dobrowolsky ... 456,804
Cuspidors, swing attachment for, S. Horseman ... 456,620
Cutter. See Twine cutter.
Decorticating fibrous plants, etc., machine for, J. H. Lorimer ... 456,730
Denture, artificial, W. H. Marshall ... 456,626
Derrick, windmill, T. O. Perry (r) ... 11,181
Digger. See Post hole digger.
Distilling apparatus, water, R. P. Barnstead ... 456,922
Door check, A. A. Page ... 456,707
Door check, G. W. Wright ... 456,748
Door track and hanger, C. O. Parsons ... 456,841
Draw bars, manufacture of, J. Green ... 456,699, 456,700
Drawing instruments, magnetized head for, R. S. Carr ... 456,553
Drier. See Grain drier.
Drill, J. Muirhead ... 456,770
Drill press, H. H. Fuller ... 456,560
Drying apparatus, V. F. L. Smidth ... 456,742
Dust collector, J. J. Gerard ... 456,810
Dye, azo, C. A. Martius ... 456,897
Dyes, making azo, C. A. Martius ... 456,627, 456,628
Dynamos driven by compressed air, regulation of, V. Popp ... 456,593
Eaves trough hanger, M. Bingham ... 456,877
Educational purposes, frame for holding blocks for, F. W. Preston ... 456,708
Electric circuit breaker for secondary generators, M. Feilbogen ... 456,889
Electric circuit changing apparatus, H. V. Hayes ... 456,817
Electric light crane, C. H. Shank ... 456,859
Electric wires, attachment for poles for, E. Verstraete ... 456,683
Electric wires, cable head for, U. H. Balsley ... 456,611
Electrical apparatus, coin-controlled, T. L. Brooks ... 456,718
Electrical distribution, system of, M. Feilbogen ... 456,888
Electro-motive-force regulator, E. M. Bentley ... 456,612
Electrode for secondary batteries, O. C. Flick ... 456,558
Elevator guard, H. D. Swift ... 456,641
Embossing machine, E. Jaeck ... 456,724
Embroidering machine, J. Irish ... 456,573
Engine. See Blowing engine. Gas or vapor engine. Pumping engine. Steam engine.
Engine bearing, Babbitt & Bailey ... 456,921
Expansion bolt, R. McGrath ... 456,588
Extensible brace for excavations, W. J. Dunn ... 456,649
Fabric turfing implement, V. Fernandez ... 456,805
Fare register, cab, W. Pigott ... 456,905
Feed rack, D. G. Hagenbaugh ... 456,563
Feed water heater, J. Baird ... 456,712, 456,713
Feed water heater, locomotive, F. L. McGahan ... 456,676
Fence, H. C. Pratt ... 456,637
File box, Osborn & Foster ... 456,591
Filter, oil, Campbell & Flower ... 456,797
Firearm lock, F. D. Granger ... 456,813
Fireman's smoke protector, W. Bader ... 456,687
Fish hook, J. T. Prior ... 456,776
Fishing boat attachment, P. Costa ... 456,720
Flour bin and sifter, J. D. Field ... 456,806
Flour bolt, O. M. Morse ... 456,584
Food compound, G. F. Ordway ... 456,903
Foot rest, T. N. Derby ... 456,557
Forging car coupling hooks, die for, J. Green ... 456,892
Fork. See Hay fork.
Fruit and vegetable scoop and knife, E. O. Varell ... 456,784
Furnace. See Reverberatory furnace.
Gauge. See Micrometer gauge. Water gauge.
Gas lighter, automatic electric, A. Wunderlich ... 456,685
Gas lighter, electric, A. Wunderlich ... 456,684
Gas or vapor engine, Rollason & Hamilton ... 456,853
Gas retort charger, A. Hickenlooper ... 456,569
Gate. See Railway crossing gate.
Gearing, chain, E. G. Latta ... 456,729
Gearing, toothed, M. P. Campbell ... 456,796
Generator. See Steam generator.
Gold chlorinating process, J. H. Pollok ... 456,844
Governor, steam engine, R. E. Olds ... 456,837
Grain bins, spout alarm for, W. G. Adams ... 456,667
Grain drier, F. H. C. Mey ... 456,782
Grate, O. Pederson ... 456,733
Grinding and amalgamating mill, M. Crawford (r) ... 11,180
Guard. See Elevator guard.
Guns, reservoir for pneumatic, H. Eichbaum ... 456,617
Hair curler, I. E. Hervey ... 456,819
Hame and horse collar, combined, N. B. Riley ... 456,850
Hammer, power, C. M. Collins ... 456,616
Hanger. See Eaves trough hanger.
Harvester, corn, McClure & Fri ... 456,657
Harvesters, sheaf carrier and dumper for, G. H. Howe ... 456,825
Hat dipping apparatus, S. T. Newman ... 456,706
Hat sweat band, T. Webb ... 456,785
Hay fork or grapple, C. Lardner ... 456,624
Hay press, C. D. McNeill ... 456,633
Hay rake and tedder, F. M. Quick ... 456,845
Hay rake, horse, A. H. Colby (r) ... 11,182
Heat into mechanical energy, transforming, H. Mebner ... 456,831
Heater. See Feed water heater. Water heater.
Hoisting and conveying apparatus, C. L. Saunders ... 456,640
Hoisting apparatus, J. Gibbins ... 456,763
Hoisting machine, electric, G. H. Reynolds ... 456,908
Holder. See Bouquet holder. Music holder. Nipple holder. Punching machine work holder.
Hollow bar, E. L. Clark ... 456,646
Hook. See Fish hook.
Hook, W. S. Whiting ... 456,786
Horse boot, M. Barnes ... 456,688
Horse detacher, E. Hays ... 456,816
Horse detacher and brake, A. H. Chilton ... 456,613
Hose coupling, C. L. Bastian ... 456,756
Hot water heater or boiler, E. D. Weston ... 456,747
Hydrocarbon burner, Blasdel & Morse ... 456,583
Ice cream freezer, Rube & Bartholomew ... 456,910
Ice shaving machine, F. O. Opitz ... 456,838
Incrustation preventive, J. Efrem ... 456,760
Incubator, A. H. Burr ... 456,794
Indicator. See Speed indicator.
Inking pad, A. Woodruff ... 456,607
Inking pads, machine for finishing, J. W. Birch ... 456,544
Insecticide, D. W. Staples ... 456,602
Insulator, span wire, W. S. Jarboe *et al* ... 456,574
Insulator, span wire, W. P. Seibert ... 456,600
Interchangeable switch and signal stand, automatic, N. W. Boyd ... 456,645
Ironing machine, J. McKay ... 456,658
Jeweler's work clamp, W. B. Fish ... 456,891
Kettle tilter, C. Shefferd ... 456,662
Knife. See Pocket knife.
Knife and scissors sharpener, A. Fritschi ... 456,618
Knitting machine clamp, S. Thurstensen ... 456,710
Knob attachment, C. L. Fitch ... 456,807
Knockdown table, E. G. Asmus ... 456,752
Ladder, extension, J. E. Gillespie ... 456,651
Lamp burner, J. E. Bohner ... 456,881
Lamp, electric arc, F. L. Sautter ... 456,598
Lamp extinguisher, J. B. Greenhalgh ... 456,814
Lamp fixture, J. E. Bohner ... 456,880
Lamp, oil, F. E. & S. Townsend ... 456,642
Lamps, letter displaying device for, Barringer & Johnston ... 456,755
Lands, means for reclaiming overflowed, T. F. Wurts ... 456,749
Lantern, A. L. Baron ... 456,924
Lantern, A. H. Crawford ... 456,721
Life preserver, C. A. L. Kopcke ... 456,621
Lock. See Alarm lock. Firearm lock. Seal lock.
Lock, W. H. Taylor ... 456,917
Loom shuttle box operating mechanism, J. D. Butler ... 456,550
Loom shuttle raceway, G. C. Moore ... 456,675
Loom temple, E. S. Stimpson ... 456,916
Lubricator, E. D. Bangs ... 456,714
Machine wrench, M. Martin ... 456,830
Magnetic separator, D. E. Lain ... 456,622
Mail bag catcher, S. Wampler ... 456,665
Malt, manufacturing, F. W. Wiesebrock ... 456,872
Mast, jury, A. McDougall ... 456,587
Meat tenderer, J. L. Fugate ... 456,670
Medical induction coil, H. A. Voelkner ... 456,746
Micrometer gauge, S. H. Bellows ... 456,875
Mill. See Grinding and amalgamating mill. Quartz mill.
Mirror, adjustable, J. & M. B. Elbert ... 456,695
Money order, safety, H. W. Campbell ... 456,885
Mop wringer, J. P. Reuter ... 456,777
Mop wringer, C. A. White ... 456,666
Motor. See Current motor.
Mower, J. F. Steward ... 456,782
Music holder, C. H. Reynolds ... 456,638
Nail puller, A. F. Street ... 456,603
Newspapers, machine for folding and mailing, J. E. Sawn ... 456,599
Nipple holder, H. B. Spencer ... 456,860
Nozzle for street sprinklers, W. H. Miller ... 456,767
Numbering machine, E. G. Bates ... 456,374
Oil and making the same, drying, N. H. Finley ... 456,890
Oil and regulating the action of hydrostatic presses, process of and apparatus for expressing, J. H. Vaile ... 456,606
Oil can and siphon pump, T. Bumann ... 456,758
Organs, combination stop action for, L. D. Morris ... 456,768
Pad. See Inking pad. Truss pad.
Padlock, W. E. Sparks ... 456,744
Paint can, C. F. & C. F. Stites ... 456,681
Paint, vulcanized, L. W. Osborn ... 456,659
Paper, coin-operated machine for furnishing toilet, B. B. Babbitt ... 456,788
Pasteboard articles, manufacture of, T. Remus ... 456,597
Pasteboard boxes, machine for connecting the corners of, Saltzkorn & Nicolai ... 456,639
Photograph apparatus, coin-controlled, F. Martin ... 456,673
Photographer's retouching and marking apparatus, C. Cutler ... 456,555
Photographic camera, E. W. Perry, Jr ... 456,842
Photographic exposures, instrument for calculating, A. Watkins ... 456,869
Pipe clamp, J. Muirhead ... 456,769
Pipe connection, N. E. Smith ... 456,781
Pipe covering, steam, C. J. W. Shearer ... 456,661
Pipe, manufacture of lead lined iron, G. W. Harrington ... 456,927
Planing machines, rotary cylinder and cutting knife for, S. Erb ... 456,761
Planter, corn, C. J. Brown ... 456,548
Pocket knife, C. Gerlach ... 456,811
Post hole digger, F. E. Kohler ... 456,655
Power. See Churn power.
Press. See Baling press. Cake press. Drill press. Hay press. Printing press.
Printers' rollers, apparatus for making, L. K. Bingham ... 456,876
Printing press, oscillating cylinder, W. Scott ... 456,741
Printing press sheet delivery apparatus, C. B. Cottrell ... 456,669
Protector. See Fireman's smoke protector. Wall protector.
Puller. See Nail puller.
Pulley, W. H. Dodge ... 456,722
Pulley, Mershon & Richters ... 456,731
Pumping engine, duplex, E. Barnes ... 456,753, 456,754
Punching machine, J. M. Long ... 456,579
Punching machine work holder, J. M. Long ... 456,578
Puzzle, M. L. Cole ... 456,554
Puzzle, E. E. Jenne ... 456,826
Quartz mill, roller, C. C. Lane ... 456,623
Quilting machine, M. Koch ... 456,726, 456,727
Quilting machine, L. Schultz ... 456,734 to 456,738, 456,740
Rack. See Feed rack.
Radiator, steam or hot water, T. C. Joy ... 456,895, 456,896
Railway, W. S. Herrington ... 456,818
Railway carriage, elevated, J. N. Valley ... 456,867
Railway carriages, brake for elevated, J. N. Valley ... 456,866
Railway crossing gate, T. Stebbins ... 456,914
Rake. See Hay rake.
Ranges, hot water apparatus for cooking, G. T. Brewer ... 456,757
Rawhide and making the same, fulled, C. L. Royer ... 456,860

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Recorder. See Time recorder.
Recording machines, marker for, J. Boyer..... 456,668
Reel. See Wire reel.
Refrigerator, J. Outhet..... 456,840
Register. See Billiard table register. Car mileage register. Cash register. Fare register.
Regulator. See Condenser regulator. Electromotive-force regulator.
Reverberatory furnace, W. Stubblebine..... 456,663
Ribbon box, J. H. Morse..... 456,630
Road roller, M. E. Hershey..... 456,567
Roller. See Road roller.
Ropeways, apparatus or grip for buckets of, W. Elligen..... 456,696
Rosette, R. W. Jones..... 456,725
Rudders, device for shipping boats', J. D. Hickman..... 456,820
Sad irons, waxing pad for, W. A. & H. E. Abbott.. 456,686
Safe, vault, etc., T. M. Brintnall..... 456,690
Sandpapering machine, H. Spoor..... 456,861
Sanitary closet, A. O'Brien..... 456,678
Sash balance, W. Berry..... 456,715, 456,716
Sash fastener, D. Cote..... 456,759
Scissors, N. A. Wheeler..... 456,870
Screw cutting die stock, F. S. Patton..... 456,660
Screw making machine, G. A. Smith..... 456,913
Seal lock, Reed & Frazer..... 456,596
Seat. See Car seat.
Secondary battery, H. Pieper..... 456,843
Separating machine, O. M. Morse..... 456,585
Separator. See Magnetic separator.
Sewing machine shuttle driving mechanism, T. Gariepy..... 456,619
Sewing machine stay cutting attachment, A. L. Coombs..... 456,692
Shaft turning machine, L. H. Brightman..... 456,882
Show stand, J. W. Tyler..... 456,865
Sign and apparatus for making the same, Blackwell, Jr., & Carlisle..... 456,545
Signaling device, railway, W. Newcomb..... 456,836
Skins, machine for coloring, A. Travis..... 456,605
Slot machine, information, A. G. Hart..... 456,566
Snow plow and rutter, I. K. Kerr..... 456,576
Speed governor, E. E. Jepsen..... 456,893
Speed indicator, Westaway & Leonard..... 456,919
Spike, rolled, H. A. Harvey..... 456,723
Spinning and twisting machines, band cylinder for, J. Hamer..... 456,765
Spring. See Car spring. Coiled spring.
Stanchion, J. O. Wicks..... 456,871
Stand. See Show stand.
Steam boiler, E. Blass..... 456,689
Steam engine, J. H. Eickershoff..... 456,694
Steam engine, S. T. Richardson..... 456,848
Steam generator, A. J. Davis..... 456,648
Stretcher for ambulances, folding, A. Brew..... 456,547
Sugar washing apparatus, R. F. Cordero..... 456,799
Sulky, W. D. Harper..... 456,565
Switch. See Interchangeable switch. Tramway switch.
Table. See Card table. Knockdown table.
Tack drawing implement, J. Reid, Jr..... 456,679
Thread cutting machine, L. Schultz..... 456,739
Thread upon disk holders, machine for winding, J. Keats..... 456,671
Tie. See Bale tie.
Time recorder, workman's, S. Hall..... 456,564
Tire, bicycle, C. F. Jacobs..... 456,702
Tire bolt wrench, J. A. Ross..... 456,778
Tire, pneumatic, J. B. McCune..... 456,771
Tire, rubber wheel, G. Ahlborn..... 456,751
Tire, vehicle wheel, J. Sheldon *et al*..... 456,779
Tire, wheel, H. Myers..... 456,705
Tobacco case, P. F. & A. E. MaGee..... 456,580
Tobacco pipe attachment, F. J. Schmehr..... 456,856
Tooth powder box, Stoddard & Cooke..... 456,709
Toy musical instrument, W. J. Broadbent..... 456,884
Tramway switch, C. A. Beach..... 456,543
Trimming machine, W. B. Boaz..... 456,879
Truck, railway, J. G. Chandler..... 456,719
Truss, G. V. House, Jr..... 456,822
Truss pad, G. V. House, Jr..... 456,823
Tube machine, G. W. Clark..... 456,615
Twine cutter, W. L. Gibson..... 456,812
Type and holder for the same, J. M. Williamson.. 456,873
Typewriting machine, E. A. Ford..... 456,808
Upright case or tool receptacle, E. G. Lamson..... 456,728
Valve for rock drills, A. W. & Z. W. Daw..... 456,801
Valve, manifold, A. Blankerts..... 456,546
Valve reseating machine, C. L. Morse..... 456,704
Valve, reversing, H. T. Clarke..... 456,886
Valve, reversing engine, R. W. Mewes..... 456,832
Vamp marking machine, C. H. Bayley..... 456,542
Varnish, lacquer, or glue, composition to be used as a, T. B. Osborne..... 456,772
Vegetable masher, K. F. Taylor..... 456,863
Vehicle brake, H. Caldwell..... 456,795
Velocipede, F. Malfait..... 456,625
Velocipede, S. E. Mosher..... 456,631, 456,632
Velocipede, F. Newhouse..... 456,590
Velocipede saddle, F. Brooks..... 456,792
Vessels, construction of, S. T. Richardson..... 456,849
Vessels, framework for, A. McDougall..... 456,586
Vignettes, machine for printing and stamping, H. Schwarz..... 456,857
Vise, double-geared self-adjusting, J. M. Hesser.. 456,568
Wagon, dumping, U. S. G. & L. D. Warner..... 456,868
Wall protector, M. T. Prescott..... 456,775
Washer for exhaust steam, Hussey & McCann..... 456,572
Watch bow fastener, F. Mink..... 456,899 to 456,902
Waterfalls, apparatus for producing artificial, F. H. Smith..... 456,680
Water gauge, D. B. Morison..... 456,629
Water heater, C. Mitchell..... 456,582
Waterproofing and preserving textures and other materials, Hime & Noad..... 456,821
Wheel. See Bicycle wheel. Car wheel. Wind wheel.
Wind wheel, M. J. Althouse..... 456,787
Windmill, J. Burnham..... 456,549
Wire nail machine, A. M. Beauchamp..... 456,789
Wire reel, F. Krohe..... 456,577
Wrench. See Machine wrench. Tire bolt wrench.
Wringer. See Mop wringer.
Zein, extracting, T. B. Osborne..... 456,773

TRADE MARKS.

Bicycles, tricycles, and velocipedes, Warman & Hazlewood..... 19,953
Blacksmiths' and machinists' small tools, including taps, dies, and the like, J. M. Carpenter Tap and Die Company..... 19,951
Canned meats, fish, fruits, vegetables, and mincemeat, Merrell & Soule..... 19,929
Cigars, I. Alvarez..... 19,936, 19,947
Cigars, Rhode & Hoffmann..... 19,931
Cigarettes, Compagnie La Ferme..... 19,939
Cosmetic, South Bend Medicine Company..... 19,945
Diamonds, artificial, G. H. Cahoone & Co..... 19,924
Extract or sirup for beverages, E. May..... 19,949
Flour, wheat, Deadwood Flouring Mill Company.. 19,940
Flour, wheat, Thompson Milling Company..... 19,952
Gum, chewing, J. K. McIlhenny..... 19,943
Horse blankets, W. B. Riley & Co..... 19,944
Hosiery, Verdier & Schultz..... 19,946
Inks, printers' and lithographers', Ault & Wiborg Company..... 19,933
Mineral waters, C. M. Boyce & Co..... 19,948
Oil finish, hard, E. M. Ezekiel..... 19,941
Oil, illuminating, J. Ellis & Co..... 19,942
Paper, writing, Nonotuck Paper Company.... 19,722, 19,923
Pills, Carter Medicine Company..... 19,938
Remedies for diseases of the stomach and bowels, Quaker Medical Association..... 19,930
Remedies for diseases of the throat and lungs, G. E. Hurd..... 19,926
Remedy for rheumatism, M. J. Cosman..... 19,937
Remedy, headache, A. C. Vosseler..... 19,934
Salve, Hall & Mathers..... 19,950
Seed meal, cotton, S. Steinhardt..... 19,932
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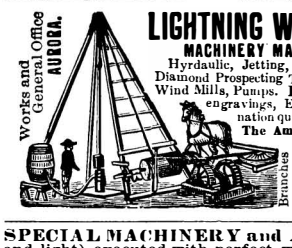

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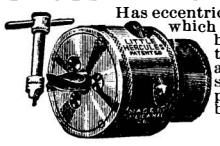

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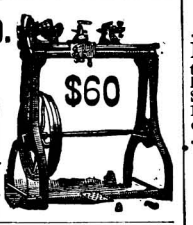

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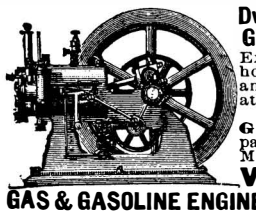

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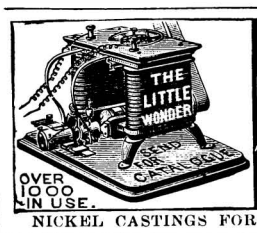

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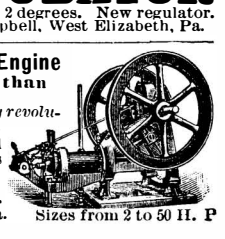

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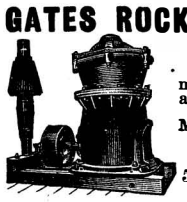

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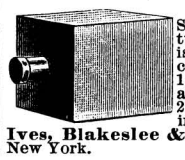

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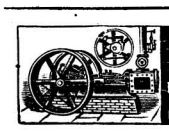

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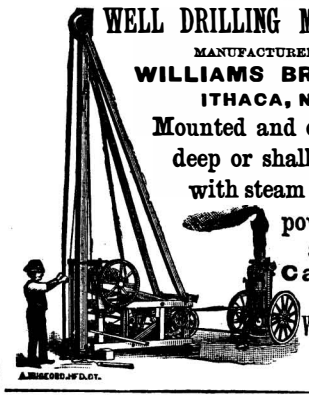

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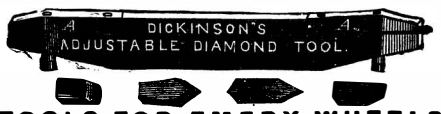

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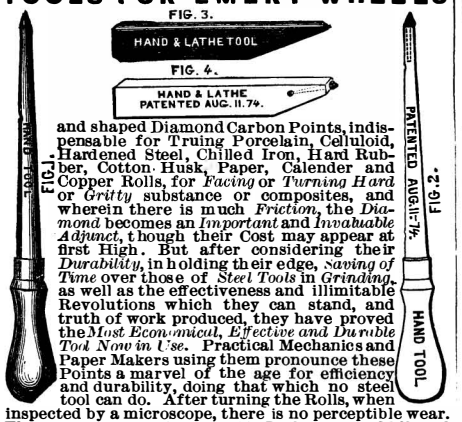

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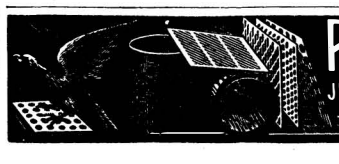

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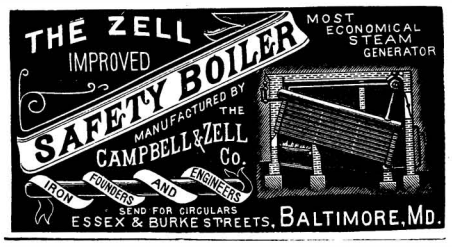

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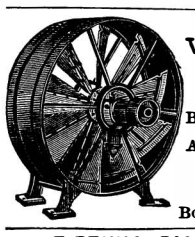

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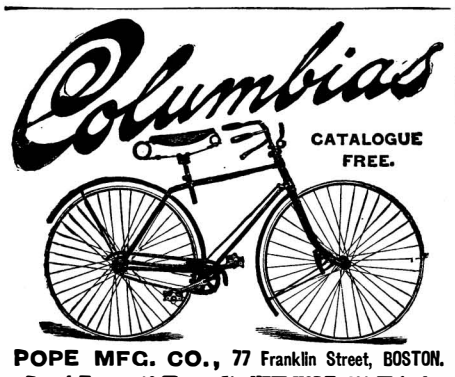

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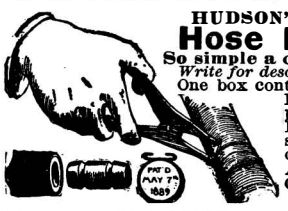

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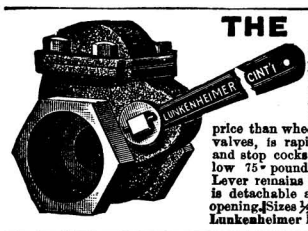

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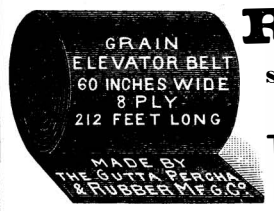

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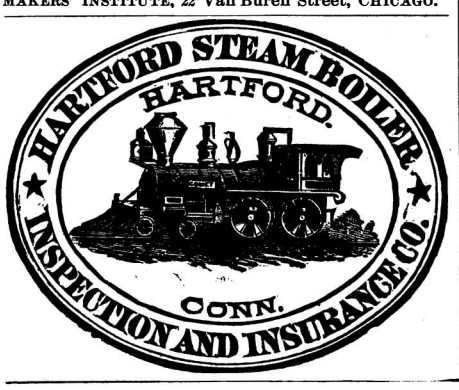

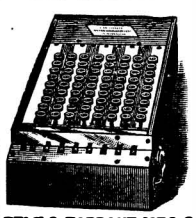

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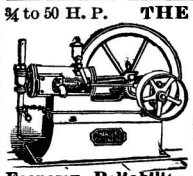

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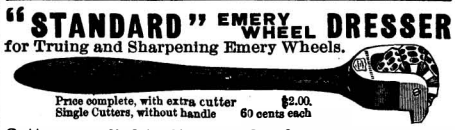

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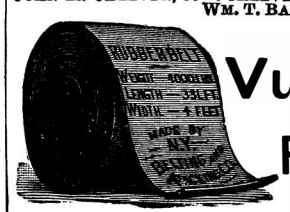

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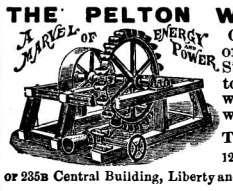

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